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Draft Recovery Plan for Gabbro Soil Plants of the Central Sierra Nevada Foothills

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Illustration of Pine Hill Flannelbush (*Fremontodendron californicum ssp. decumbens*) from Lloyd 1965, with permission.

DRAFT RECOVERY PLAN

FOR

GABBRO SOIL PLANTS

OF THE

CENTRAL SIERRA NEVADA FOOTHILLS

(December 1998)

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EXECUTIVE SUMMARY

Introduction: This recovery plan features six species of plants that occur exclusively or primarily on gabbro soils in chaparral and woodland in the Central Sierra Nevada foothills in California. The five federally listed species include four endangered plants (Stebbins' morning-glory, Pine Hill ceanothus, Pine Hill flannelbush, and El Dorado bedstraw), and one threatened plant (Layne's butterweed).

In addition, El Dorado mule-ears, a species of concern, is addressed. Conversion of habitat to urban and industrial uses has extirpated occurrences of the listed species and species of concern and degraded their habitat. The gabbro habitat in the southern portion of the Pine Hill formation is especially fragmented. Limited suitable "pristine" habitat is left for a preserve system especially in the southern portion of the Pine Hill formation.

The Endangered Species Act mandates the preparation of recovery plans for listed species unless such a plan would not contribute to their conservation. Recovery plans detail the actions necessary to achieve self-sustaining, wild populations of listed species so they will no longer require protection under the Endangered Species Act. Species of concern are not required to have recovery plans. However, non-listed species are included in this recovery plan because a community-level strategy provides opportunities for pre-listing conservation of species with needs similar to those of listed species.

Recovery Objectives: The ultimate goal of this recovery plan is to delist the five endangered and threatened species, and to ensure the long-term conservation of El Dorado mule-ears. An interim goal is to downlist the endangered species to threatened status.

Community-level Strategy for Recovery and Conservation: This plan presents a community-level strategy for recovery and conservation because all of the listed species and species of concern co-occur in the same natural community.

The likelihood of successful recovery for listed species is increased by protecting entire communities, and by doing so, conservation of species of concern is also possible. The community-level strategy is determined by the available information on biology, distribution, and population statuses of covered species; extent, location, and quality of existing habitats; and how present and anticipated biological and anthropological impacts will affect the covered species in the human-dominated landscape in western El Dorado County.

The four key elements that compose this community-level recovery and conservation strategy are described below.

1. Recovery criteria

The community-level approach facilitates species recovery and conservation but does not negate the need to consider the requirements of each species. Thus, individual recovery criteria are presented for each of the six species covered in this plan to track their progress towards recovery or conservation and to ensure that all of their recovery and conservation needs are addressed.

Separate criteria are given in the recovery plan for downlisting four species from endangered to threatened, for delisting Layne's butterweed, and for achieving long-term conservation of El Dorado mule ears. Elements common to the recovery criteria of most listed species include:

- protection from development and incompatible uses of the habitat of populations representing the full range of genetic and geographic variation in the species; and

- achievement of self-sustaining status in specified populations.

Protection strategies for the species of concern are based on the assumptions that if populations are secure from threats, co-occur with listed species, are not declining, and populations remain in habitat remnants throughout

5

the species' historical range, their long-term conservation will be ensured.

2. Habitat protection

Considering that habitat loss is the primary cause of species endangerment for the gabbro soil plants, a central component of species recovery and conservation is to establish a network of conservation areas and reserves that represent most of the important gabbro habitat in western El Dorado County.

3. Monitoring and research programs

This recovery plan has been developed based on the best scientific information currently available. However, many important aspects of species biology and management have not yet been studied. Thus, continued research, in conjunction with adaptive management is a crucial component of this plan. Recovery criteria and tasks must be reevaluated for each species as research is completed.

Primary information needs for the species covered in this plan are:

- surveys to determine species distributions;
- population censusing and monitoring;
- reproductive and demographic studies;
- habitat management research;
- population genetics studies; and
- habitat and species restoration trials.

4. Habitat management

In most cases, active management of the land is necessary to maintain and enhance habitat values for the species covered in this plan. However, management strategies have not been investigated for most species. Management research (element #3) may take many years to complete, and few management plans have been developed for protected areas. The only practical approach is adaptive management, where management is applied, population responses are monitored, the outcome is evaluated, and management is readjusted accordingly.

Implementation Participants: Although we (the U.S. Fish and Wildlife Service) have the statutory responsibility for implementing this recovery plan, and only Federal agencies are mandated to take part in the effort, the participation of a variety of groups in both initial plan implementation and the subsequent adaptive management process, is essential to successful recovery. Thus, the plan recommends the establishment of a regional, cooperative public/private recovery plan implementation team to enlist the participation of all stakeholder groups and interested parties. This group would develop a participation plan, coordinate education and outreach efforts, assist in developing economic incentives for conservation and recovery, ensure that adaptive management is practiced, and define other recovery and management tasks as necessary.

Total Estimated Cost of Recovery: The total estimated cost of recovery for the five listed plant species and the one species of concern is broken down by priority of tasks. Certain costs, such as securing and protecting serpentine habitat in Nevada County and the cost of long term management, have yet to be determined.

Priority 1 tasks: $33,254,000+

Those actions that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2 tasks: $16,644,600+

Those actions that must be taken to prevent a significant decline in the species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 tasks: $20,000

All other actions necessary to meet the recovery and conservation objectives outlined in this recovery plan.

Date of Recovery: Because recovery is defined in relation to a fire cycle for most species covered in this recovery plan, the date of recovery is anticipated for most listed species to be approximately between 80 and 100 years.

TABLE OF CONTENTS

Page #

I. INTRODUCTION I-1

II. SPECIES ACCOUNTS

- **A. Species Habitats and Descriptions** II-1
- **1. Stebbins' Morning-glory (*Calystegia stebbinsii*)**
  - **Taxonomy** II-4
  - **Description** II-4
  - **Historical and Current Distribution** II-8
- **2. Pine Hill Ceanothus (*Ceanothus roderickii*)**
  - **Taxonomy** II-8
  - **Description** II-10
  - **Historical and Current Distribution** II-10
- **3. Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*)**
  - **Taxonomy** II-10
  - **Description** II-10
  - **Historical and Current Distribution** II-14
- **4. El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*)**
  - **Taxonomy** II-14
  - **Description** II-14
  - **Historical and Current Distribution** II-16
- **5. Layne's Butterweed (*Senecio layneae*)**
  - **Taxonomy** II-16
  - **Description** II-17
  - **Historical and Current Distribution** II-17
- **6. El Dorado Mule-ears (*Wyethia reticulata*)**
  - **Taxonomy** II-17
  - **Description** II-19
  - **Historical and Current Distribution** II-19

B. Demography and Ecology

9

1. Stebbins' Morning-glory (*Calystegia stebbinsii*) II-21
2. Pine Hill Ceanothus (*Ceanothus roderickii*) .. II-22
3. Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*) II-24
4. El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*) II-26
5. Layne's Butterweed (*Senecio layneae*) II-26
6. El Dorado Mule-ears (*Wyethia reticulata*).... II-27
7. Fire Ecology II-27

C. Reasons for Decline and Threats to Survival II-28

D. Conservation Efforts II-32

III. RECOVERY

A. Objectives III-1
1. Multispecies Strategy III-1
2. Habitat Considerations III-3
3. Individual Species Considerations III-4

B. Recovery Criteria III-6

C. Recovery Priorities III-14

IV. STEPDOWN NARRATIVE IV-1

V. IMPLEMENTATION SCHEDULE V-1

VI. REFERENCES

A. Literature Cited VI-1

B. Personal Communications VI-7

C. In Litt. References VI-7

VII. APPENDICES

A. Priorities for Recovery of Threatened and Endangered Species VII-1

B. Analysis of Potential Preserve Sites (El Dorado County Planning Staff 1992) VII-2

C. Land Characteristics of Four of the Five Rare Plant Preserves (Economic & Planning Systems, Inc. 1997) VII-13

D. Major Research and Management Needs for Species Covered in the Plan VII-19

LIST OF TABLES

Chapter I:

Table I-1. Species covered in the gabbro draft recovery plan I-3

Chapter II:

Table II-1. Special status plant species associated with gabbro soils in western El Dorado County on the Pine Hill formation II-5
Table II-2. Estimated percentage distribution of the special status plants within the southern, central, and northern areas of the Pine Hill formation II-6
Table II-3. Summary of potential preserves sites on the Pine Hill formation (EIP Associates 1991) II-35
Table II-4. El Dorado County Rare Plant Advisory Committee recommendations for preserve system II-36

Chapter III:

Table III-1. Sizes of preserves needed within the Pine Hill formation III-7
Table III-2. Generalized recovery criteria for federally listed plants and conservation criteria for *Wyethia reticulata* III-9

Chapter IV:

Table IV-1. Geographic areas targeted for protection of two or more species covered in the plan IV-3
Table IV-2. Geographic areas targeted for protection of single species covered in the plan IV-7
Table IV-3. Directed survey needs of historic and potential habitat by geographic area IV-13
Table IV-4. Research needs by geographic area IV-14
Table IV-5. Plant taxa for which seeds need to be stored IV-18

LIST OF FIGURES

Chapter I:

Figure I-1. Area map showing counties referred to in the plan I-2
Figure I-2. Map showing the Pine Hill formation I-4
Figure I-3. Map showing Rescue soil series on the Pine Hill formation ... I-6

Chapter II:

Figure II-1. Map showing vegetation communities on the Pine Hill formation II-2
Figure II-2. Illustration of Stebbins' Morning-glory (*Calystegia stebbinsii*) (from Hickman 1993, with permission) II-7
Figure II-3. Distribution of *Calystegia stebbinsii* and *Senecio layneae* II-9
Figure II-4. Illustration of Pine Hill Ceanothus (*Ceanothus roderickii*) (from Hickman 1993, with permission) II-11
Figure II-5. Distribution of gabbro plants on the Pine Hill formation II-12
Figure II-6. Illustration of Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*) (from Lloyd 1965, with permission) II-13
Figure II-7. Illustration of El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*) (from Dempster and Stebbins 1968, with permission) II-15
Figure II-8. Illustration of Layne's Butterweed (*Senecio layneae*) (from Abrams and Ferris 1960, with permission) II-18
Figure II-9. Illustration of El Dorado Mule-ears (*Wyethia reticulata*) (from Abrams and Ferris 1960, with permission) II-20
Figure II-10. El Dorado County Rare Plant Advisory Committee recommendations for preserve system and recovery plan recommendations for preserve system on the Pine Hill formation II-37

12

I. INTRODUCTION

In the Sierra Nevada foothills in California, gabbro soils are found within discontinuous rock outcrops from Plumas to Tuolumne Counties (Figure I-1). Gabbro soils are derived from mafic rocks (high in magnesium and iron) and are composed of the minerals plagioclase, olivine, clinopyroxene, iron oxides, and hornblende (Hunter and Horenstein 1991). Gabbro, a dark large-crystalline rock, is formed when liquid magma cools slowly underground. A red soil is formed when the rock is exposed and weathers at the earth's surface (EIP Associates 1991). Gabbro soils are well-drained and are underlain by gabbrodiorite rocks at a depth of more than 1 meter (3.28 feet) (U.S. Department of Agriculture, Soil Conservation Service 1974).

The six plants addressed in this recovery plan, *Calystegia stebbinsii* (Stebbins' morning-glory), *Ceanothus roderickii* (Pine Hill ceanothus), *Fremontodendron californicum* ssp. *decumbens* (Pine Hill flannelbush), *Galium californicum* ssp. *sierrae* (El Dorado bedstraw), *Senecio layneae* (Layne's butterweed), and *Wyethia reticulata* (El Dorado mule-ears) (hereafter collectively called the gabbro plants) (Table I-1), are restricted chiefly to gabbro or its derived soils. These plants occur primarily on the Pine Hill formation, an area of approximately 10,400 hectares (25,700 acres), in western El Dorado County (Figure I-2). *Ceanothus roderickii*, *F. californicum* ssp. *decumbens*, and *G. californicum* ssp. *sierrae* are endemic to gabbro-derived soils on the Pine Hill formation, and *C. stebbinsii* and *S. layneae* occur on gabbro and serpentine-derived soils. One known occurrence of *S. layneae* is found on metamorphic-derived soils. Two of these plants, *C. stebbinsii* and *S. layneae*, have a few known isolated occurrences off of the Pine Hill formation in either El Dorado, Nevada, Tuolumne, or Yuba counties, California.

The Pine Hill formation ranges in height from 628 meters (2,060 feet) at its peak down to 138 meters (453 feet) near the northwest edge. A majority of the Pine Hill formation lies between 390 to 420 meters (1,279 to 1,377 feet), which is distinctly higher than the surrounding land. Pine Hill is covered by three distinct vegetative types; grassland, oak woodland, and chaparral. A majority, 66 percent,

Figure I-1. Area map showing counties referred to in the plan.

TABLE I-1. Species covered in the gabbro draft recovery plan.

Species	State/Federal Status	Recovery Priority[1]
Calystegia stebbinsii Stebbins' morning-glory	CE/FE	5C
Ceanothus roderickii Pine Hill ceanothus	CR/FE	5C
Fremontodendron californicum ssp. *decumbens* Pine Hill flannelbush	CR/FE	3
Galium californicum ssp. *sierrae* El Dorado bedstraw	CR/FE	6C
Senecio layneae Layne's butterweed	CR/FT	5C
Wyethia reticulata El Dorado mule-ears	--/SC	

CE - California Endangered
CR - California Rare

FE - Federal Endangered
SC - Federal Species of Concern
FT - Federal Threatened

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[1] Recovery Priority: See Appendix A for an explanation of how recovery priorities are assigned for listed species.

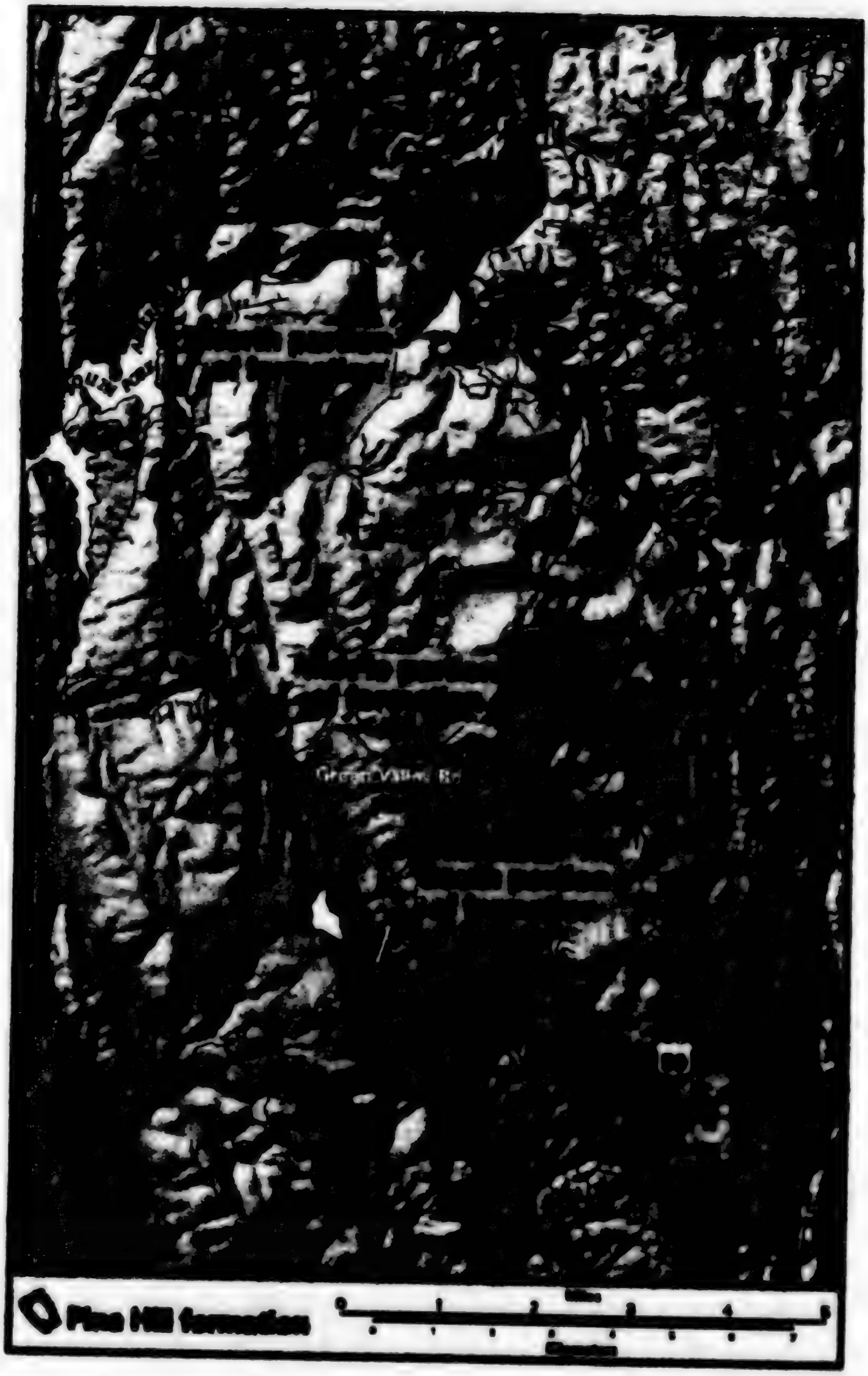

Figure I-2. Map showing the Pine Hill formation.

of Pine Hill is covered with chaparral species such as white leaf manzanita (*Arctostaphylos viscida*), chamise (*Adenostoma fasciculatum*), buck brush (*Ceanothus cuneatus*), Lemmon's ceanothus (*Ceanothus lemmonii*), toyon (*Hetermomeles arbutifolia*), and coffeeberry (*Rhamnus californica*). The remaining portions of Pine Hill are covered equally with oak woodland, dominated by black oak (*Quercus kelloggi*) and interior live oak (*Quercus wislizenii*), and grassland habitats. Pine Hill is composed of a series of interconnecting ridges and drained by a number of streams. One major river, the South Fork of the American River, bisects Pine Hill as it flows out of the Sierra Nevada. The ridges on Pine Hill are wide and rounded, almost plateau-like with large areas near the ridge tops of less than 10 percent slope. In general, the slopes on Pine Hill are moderate (less than 50 percent), except for the American River Canyon which has slopes greater than 50 percent (Hunter and Horenstein 1991).

Gabbro plants are most commonly associated with the Rescue soils series, especially Rescue very stony sandy loam and Rescue extremely stony sandy loam, on the Pine Hill formation (EIP Associates 1991) (Figure I-3). The Rescue series soils are well drained soils that are underlain by gabbrodiorite (granular igneous) rocks. The surface layer of these soils is reddish-brown sandy loam about 25 centimeters (10 inches) thick. Subsoils are reddish-yellow and vary in texture from sandy to clayey. Beneath the subsoil, underlying materials are coarser and sandier (U.S. Department of Agriculture, Soil Conservation Service 1974). Rescue very stony sandy loam and Rescue extremely stony sandy loam are associated with slopes and ridge tops. The very stony sandy loam is similar to the typical sandy loam profile except that stones occupy 1 to 3 percent of the soil. The extremely stony sandy loam is characterized by numerous rock outcrops (rocks cover 3 to 15 percent of the soil) and the soil's surface layer is only 7.5 to 20 centimeters (3 to 8 inches) thick (Hunter and Horenstein 1991).

Several comparisons have been made between gabbro and serpentine soils. Many species that are considered endemic to serpentine soils are also found on gabbro soils (Wilson 1986, Hunter and Horenstein 1991). Both soil types are considered to be similar because they support unique assemblages of plant species, have similar mineral compositions, and appear to influence plant

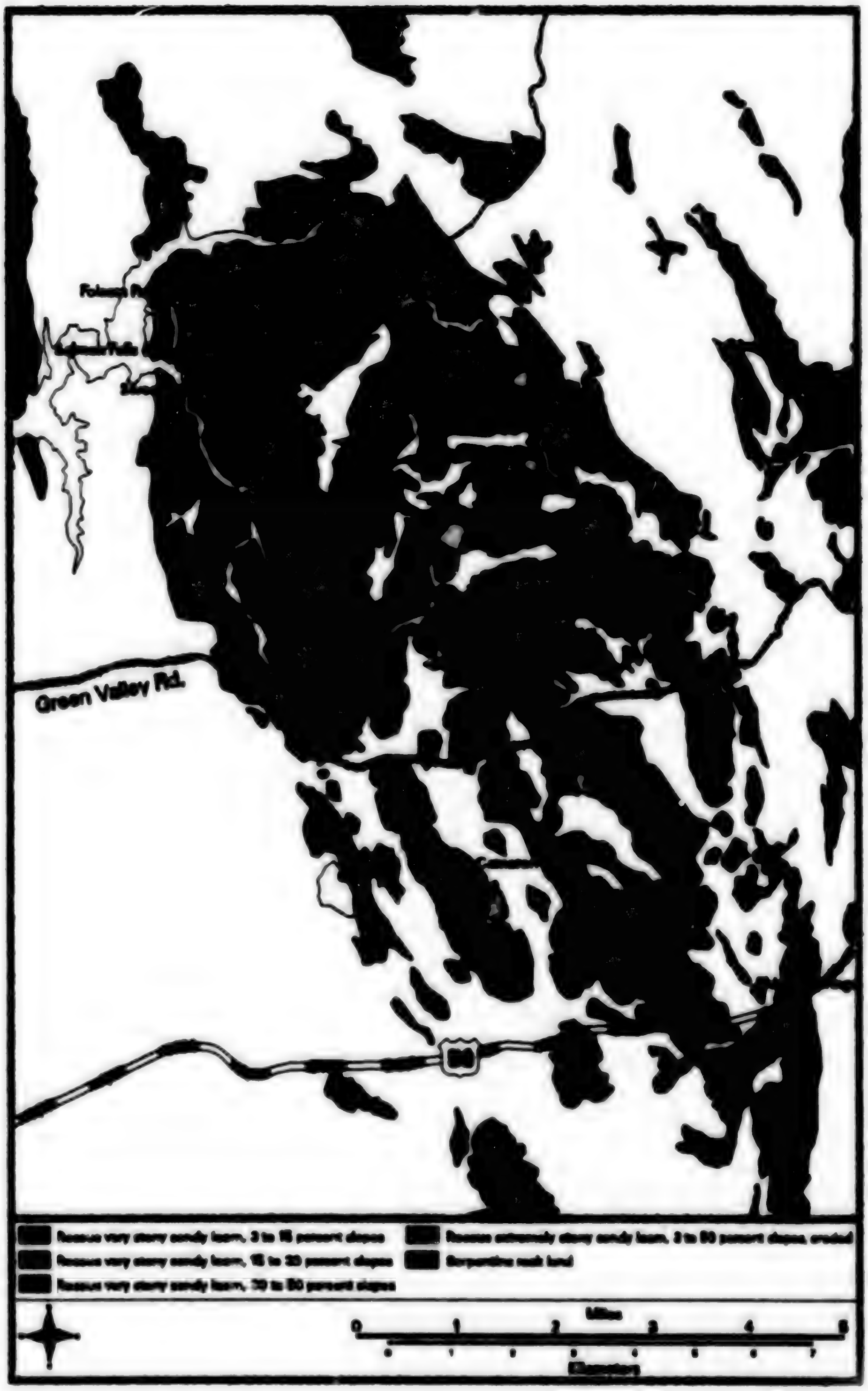
Green Valley Rd.
50
Rescue very stony sandy loam, 3 to 15 percent slopes
Rescue very stony sandy loam, 15 to 30 percent slopes
Rescue very stony sandy loam, 30 to 50 percent slopes
Rescue extremely stony sandy loam, 3 to 50 percent slopes, eroded
Serpentine rock land
Miles
0
1
2
3
4
5
0
1
2
3
4
5
6
7
Kilometers

Figure I-3. Map showing Rescue soil series on the Pine Hill formation.

distributions in much the same way. In addition, serpentine-derived soils are formed through a process similar to the formation of gabbroic soils. Serpentine soils are formed from weathered ultramafic (extremely basic) rocks such as serpentinite, dunite, and peridotite.

Serpentine endemic plants make up 10 percent of the flora within the State of California (Kruckeberg 1984). Despite the high diversity of plant species that are known endemics on serpentine soils, serpentine environs support very little total plant biomass. Serpentine soils provide a harsh environment for plant growth. Species that have been able to colonize these harsh environs have been forced to genetically adapt to the barren serpentine condition. Several factors contribute to the inhospitability of serpentine soils to plant growth including: 1) a low calcium/magnesium ratio; 2) lack of essential nutrients such as nitrogen, potassium, and phosphorous; and 3) high concentrations of heavy metals (mineral toxicity) (Kruckeberg 1984).

Gabbro soils, in comparison, are rich in iron and magnesium and contain low concentrations of cobalt, chromium, and nickel (Wilson 1986; Hunter and Horenstein 1991). Gabbro soils have calcium/magnesium ratios that are slightly lower than more silicate rocks that have less calcium, but have much higher calcium/magnesium ratios than serpentine soils (Alexander 1991). The calcium/magnesium quotients of Pine Hill gabbro soils average 1.66 and range from 0.625 to 3.33 (Hunter and Horenstein 1991). Serpentine soils, in comparison, typically have a very low calcium to magnesium ratio, around 1.0. McCarten (1986) found that the calcium-magnesium ratio within San Francisco Bay area serpentine soils ranged from 0.04 to 0.7.

Pine Hill gabbro soils are not as restrictive to plant inhabitation as serpentine soils. Nearly 74 percent of the 343 species that grow in the general area of the Pine Hill formation were found on gabbro soils, while 41 percent of the areas species were found on serpentine soils. Gabbro and serpentine soils were further compared with the more common metamorphic and granitic soils of the areas which were found to possess 66 percent of the areas plant species. However, it was found that serpentine soils supported a significantly greater number of native plants species than the gabbro, granite, and metamorphic soils (76 percent as compared to 64 percent, 37 percent, and 62 percent respectively) (Wilson 1986).

The reasons for the significant diversity of plant species and the presence of several endemic plant species on the Pine Hill gabbro formation are not fully known. There are several gabbro and serpentine outcrops that occur throughout the Sierra Nevada Mountain Range that do not support endemic species (Hunter and Horenstein 1991). Based on a comparison of serpentine soil quality with that of gabbro soil, it does not appear that they are as similar as was previously believed.

Most botanists agree that a combination of several different unique conditions are responsible for local endemism of numerous plants on the Pine Hill formation. These conditions may include suboptimum soil fertility in gabbro soils, topographic relief, climate, location, and stratum. Pine Hill is a unique ecosystem that covers elevations that are distinctly higher than the surrounding lands. There are several plants that have found distinct niches on the Pine Hill formation. Both Ponderosa pine *(Pinus ponderosa)* and incense cedar (*Calocedrus decurrens*), which only occur at the top of Pine Hill, are regularly found throughout the mixed conifer zone of the Sierra Nevada Mountains, which ranges in elevation from 900 to 2,000 meters (3,000 to 6,000 feet). The gabbro soils on Pine Hill are not as favorable for plant growth as the surrounding granitic and metamorphic substrates that occur off the gabbro formation. Pine Hill soils are composed of very thin topsoils covered with significant amounts of rock, a condition unfavorable for plant growth. Wilson (1986) found differences in habitat type relative to substrate and aspect. Pine Hill oak woodlands were found on metamorphic north-facing slopes, whereas chaparral was found on north-facing gabbro substrates. The unique combination of factors discussed above partially answer the question of why Pine Hill supports several locally endemic plant species. Before the total picture can be drawn, numerous other factors will need to be considered by future botanists and geologists.

II. SPECIES ACCOUNTS

A. Species Habitats and Descriptions

A total of 740 plant species have been recorded from the Pine Hill gabbro formation and adjoining serpentine and metamorphic rocks. Approximately 10 percent of the native plant species known from California are represented within this tiny fraction of the State (Horenstein and Ehrgott 1997). The three plant communities occurring on the Pine Hill formation in western El Dorado County are chaparral, woodland, and grassland. The vegetation type of this area is distinctive enough that Robert Holland (1986), based upon Wilson (1986), designated a community known as gabbroic northern mixed chaparral, a community restricted to Rescue stony loam soils of western El Dorado County, in the Pine Hill area. Holland (1986), based on work by Wilson (1986), characterized this community as being restricted to ultramafic gabbro soils in a mixed chaparral dominated by *Adenostoma fasiculatum* (chamise), and usually occurring on rather dry or arid (xeric) exposures. Sawyer and Keeler-Wolf (1995) have included gabbroic northern mixed chaparral within the Chamise series and Whiteleaf manzanita series.

Hunter and Horenstein (1991) synthesized information on the vegetation of the Pine Hill formation. Chaparral, woodland and grassland occupy 66.3 percent, 17.6 percent, and 16.9 percent of the Pine Hill formation respectively (Hunter and Horenstein 1991). Chaparral vegetation is dominated by evergreen woody shrubs that have small thick leaves. Three groupings of chaparral occur on the Pine Hill formation-- dense chaparral, open chaparral, and chaparral-woodland (Figure II-1). Dense chaparral, with greater than 75 percent cover, comprises 21.7 percent of the total area of the Pine Hill formation. Many patches of dense chaparral are nearly pure stands of either *Adenostoma fasciculatum* (chamise) or *Arctostaphylos viscida* (whiteleaf manzanita) with little understory (Hunter and Horenstein 1991). Open chaparral, with a canopy cover of 20 to 75 percent, comprises 21.7 percent of the total area. *Adenostoma fasciculatum* or *Arctostaphylos viscida* are dominants in the open chaparral. Representative understory species include *Lepechinia calycina* (woodbalm), *Diplacis aurantiacis*

21

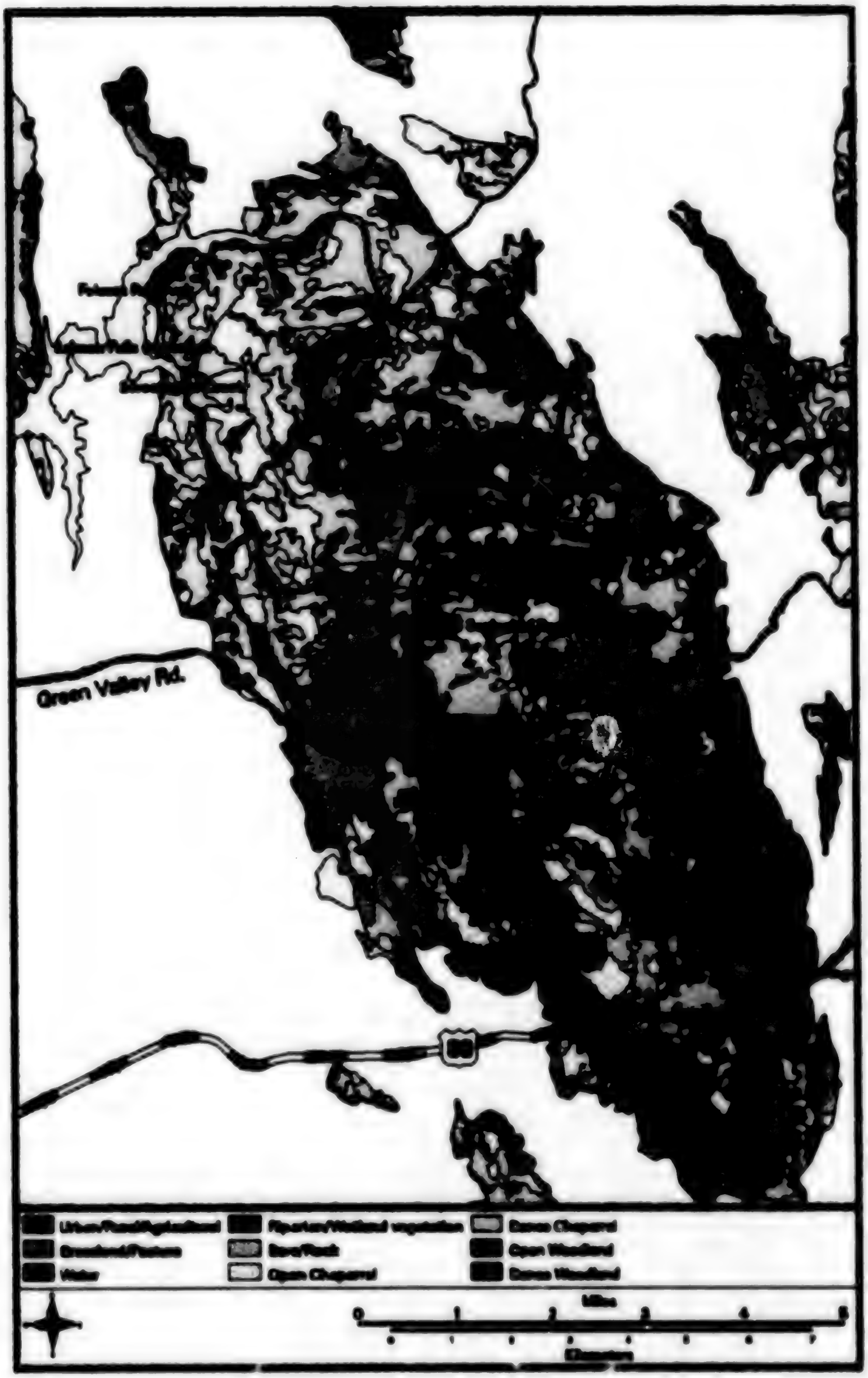

Figure II-1. Map showing vegetation communities on the Pine Hill formation.

22

(orange bush monkeyflower), *Polygala cornuta* (Sierran milkwort), *Salvia sonomensis* (creeping sage), *Brodiaea* ssp. (brodiaea), and *Bromus* ssp. (brome) (Hunter and Horenstein 1991). Open chaparral patches are highly associated with Rescue extremely stony sandy loam soils, where many of the restricted gabbro species occur. Chaparral-woodland comprises 28.2 percent of the total area and differs from dense chaparral chiefly in that the canopy dominance is shared by trees (mainly *Quercus wislizenii* (interior live oak) and *Cercis occidentalis* (California redbud)) and shrubs (Hunter and Horenstein 1991).

Patches of grasslands covering 16.9 percent of the Pine Hill formation are primarily anthropogenic (human-caused). They are dominated by nonnative grasses and forbs that are primarily annual. None of the restricted gabbro species occur in the grasslands (Wilson 1986, Hunter and Horenstein 1991).

Woodland covers 17.6 percent of the area. Typically woodlands have a discontinuous tree canopy, a sub-canopy of shrubs also present in chaparral, some vines, and an herbaceous understory. Although the chaparral dominants *Adenostoma* and *Arctostaphylos* are frequently present in the shrub layer, *Cercis occidentalis* (California redbud), *Rhamnus californica* (California buckthorn), and *Heteromeles arbutifolia* (toyon) are more abundant. The vine *Toxicodendron diversiloba* (Pacific poison oak) is abundant within most woodlands. Other vines present include *Clematis virgata* (virgin's bower), *Lonicera hispida* (California honeysuckle), *Galium nuttallii* (climbing bedstraw), *Aristolochia californica* (California dutchman's pipe), *Rubus ursinus* (California blackberry), and *Vitis californica* (California wild grape). A number of herbs that are absent from chaparral occur in the woodlands, such as *Sanicula pinnatifida* (poison sanicle) and *Plantago lanceolata* (narrow leaf plantain).

The woodlands are a heterogeneous group including riparian corridors and oak woodlands. Riparian woodlands are most commonly dominated by *Populus fremontii* (Fremont's cottonwood), *Quercus lobata* (California white oak), and *Salix* (willow) species. Other canopy species frequently present in riparian woodlands include *Acer negundo* (box elder), *Alnus rhombifolia* (white alder), *Fraxinus latifolia* (Oregon ash), *Styrax officinalis* (drug snowbell), and *Umbellularia californica* (California bay). Outside riparian corridors, *Quercus*

C. Land Characteristics of Four of the Five Rare Plant Preserves (Economic & Planning Systems, Inc. 1997) VII-13
D. Major Research and Management Needs for Species Covered in the Plan VII-19

douglasii (blue oak) and *Q. wislizenii* (interior live oak) dominate most woodlands, and *Aesculus californica* (California buckeye) and *Pinus sabiniana* (Foothill pine) are frequently present. Some patches of woodland are dominated by *Quercus kelloggii* (California black oak) and *Pinus ponderosa* (Ponderosa pine), particularly on the north flanks of the higher hills, along the American River Canyon, and in drainages near the American River.

Eight rare plant species are associated with gabbroic or serpentine-derived soils near the Pine Hill formation in western El Dorado County within chaparral or woodland communities--the six target species of this recovery plan (Tables II-1 and II-2) plus two other species. These two other species, *Chloragalum grandiflorum* (Red Hills soaproot) and *Helianthemum suffrutescens* (Bisbee Peak rush rose), will be covered in other recovery plans because the majority of the occurrences occur off gabbro.

1. Stebbins' Morning-glory (*Calystegia stebbinsii*)

Taxonomy - G. Ledyard Stebbins collected the type specimen (a specimen or series of specimens chosen when the taxon is described) of *Calystegia stebbinsii* (Stebbins' morning-glory) in 1970, 17 kilometers (10 miles) west of Placerville in El Dorado County, California. Brummitt (1974) described the species using specimens collected by Stebbins as the type. A taxon (plural=taxa) is any taxonomic grouping of any rank, for example a family, species, or subspecies.

Description - *Calystegia stebbinsii* is a leafy perennial herb in the morning-glory family (Convolvulaceae) (Figure II-2). Its stems, which range up to 1 meter (3.28 feet) in length, generally lie flat on the ground. The leaves are palmately lobed with the two outermost lobes being divided again. The leaf lobes are narrow and lance-shaped. White flowers, which appear in May through June, are on stalks 3 to 13 centimeters (1 to 5 inches) long and bear two leaf-like bracts. The fruit is a slender capsule. *Calystegia stebbinsii* flowers from May through June. *Calystegia occidentalis* (chaparral false bindweed) and *Calystegia purpurata* ssp. *saxicola* (Pacific false bindweed) also occur on gabbro related soils in the Pine Hill area (Wilson 1986). *Calystegia stebbinsii* can be

24

Table IV-3. Directed survey needs of historic and potential habitat by geographic area IV-13
Table IV-4. Research needs by geographic area IV-14
Table IV-5. Plant taxa for which seeds need to be stored IV-18

Table II-1. Special status plant species associated with gabbro soil in western El Dorado County on the Pine Hill formation.

Species	**Known Worldwide Range**	**Occurrence in Other Counties**
Calystegia stebbinsii Stebbins' morning-glory	Northern and southern part of Pine Hill geologic formation; also, near Grass Valley in Nevada County.	Nevada County has one small localized area along McCourtney Road
Ceanothus roderickii Pine Hill ceanothus	Pine Hill geologic formation in El Dorado County	None
Fremontodendron californicum ssp. *decumbens* Pine Hill flannelbush	Within 1.25 kilometers (2 miles) of the summit of Pine Hill in El Dorado County	None verified; specimens from two small populations need to be identified
Galium californicum ssp. *sierrae* El Dorado bedstraw	Pine Hill geologic formation in El Dorado County	None
Senecio layneae Layne's butterweed	Foothills of El Dorado, Yuba, and Tuolumne counties	One small localized area in Tuolumne County and one small localized area in Yuba County
Wyethia reticulata El Dorado mule-ears	Pine Hill geologic formation in El Dorado County	None

25

recommendations for preserve system on the Pine Hill formation II-37

12

Table II-2. Estimated percentage distribution of the special status plants within the southern, central, and northern areas of the Pine Hill formation.[1]

Species	South	Middle	North	Other
Calystegia stebbinsii Stebbins' morning-glory	45 percent 174 hectares (430 acres)		47 percent 182 hectares (450 acres)	8 percent 28 hectares (70 acres)
Ceanothus roderickii Pine Hill ceanothus	56 percent 219 hectares (540 acres)	10 percent 40 hectares (100 acres)	34 percent 134 hectares (330 acres)	
Fremontodendron californicum ssp. *decumbens* Pine Hill flannelbush		100 percent 154 hectares (380 acres)		
Galium californicum ssp. *sierrae* El Dorado bedstraw	58 percent 57 hectares (140 acres)	17 percent 16 hectares (40 acres)	25 percent 24 hectares (60 acres)	
Senecio layneae Layne's butterweed	49 percent 198 hectares (490 acres)	12 percent 47 hectares (115 acres)	6 percent 24 hectares (60 acres)	33 percent 134 hectares (330 acres)
Wyethia reticulata El Dorado mule-ears	57 percent 287 hectares (710 acres)	30 percent 150 hectares (370 acres)	13 percent 65 hectares (160 acres)	

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[1] See Figure I-2 for locations of the south, middle, and north areas within the Pine Hill formation.

The Pine Hill formation ranges in height from 628 meters (2,060 feet) at its peak down to 138 meters (453 feet) near the northwest edge. A majority of the Pine Hill formation lies between 390 to 420 meters (1,279 to 1,377 feet), which is distinctly higher than the surrounding land. Pine Hill is covered by three distinct vegetative types; grassland, oak woodland, and chaparral. A majority, 66 percent,

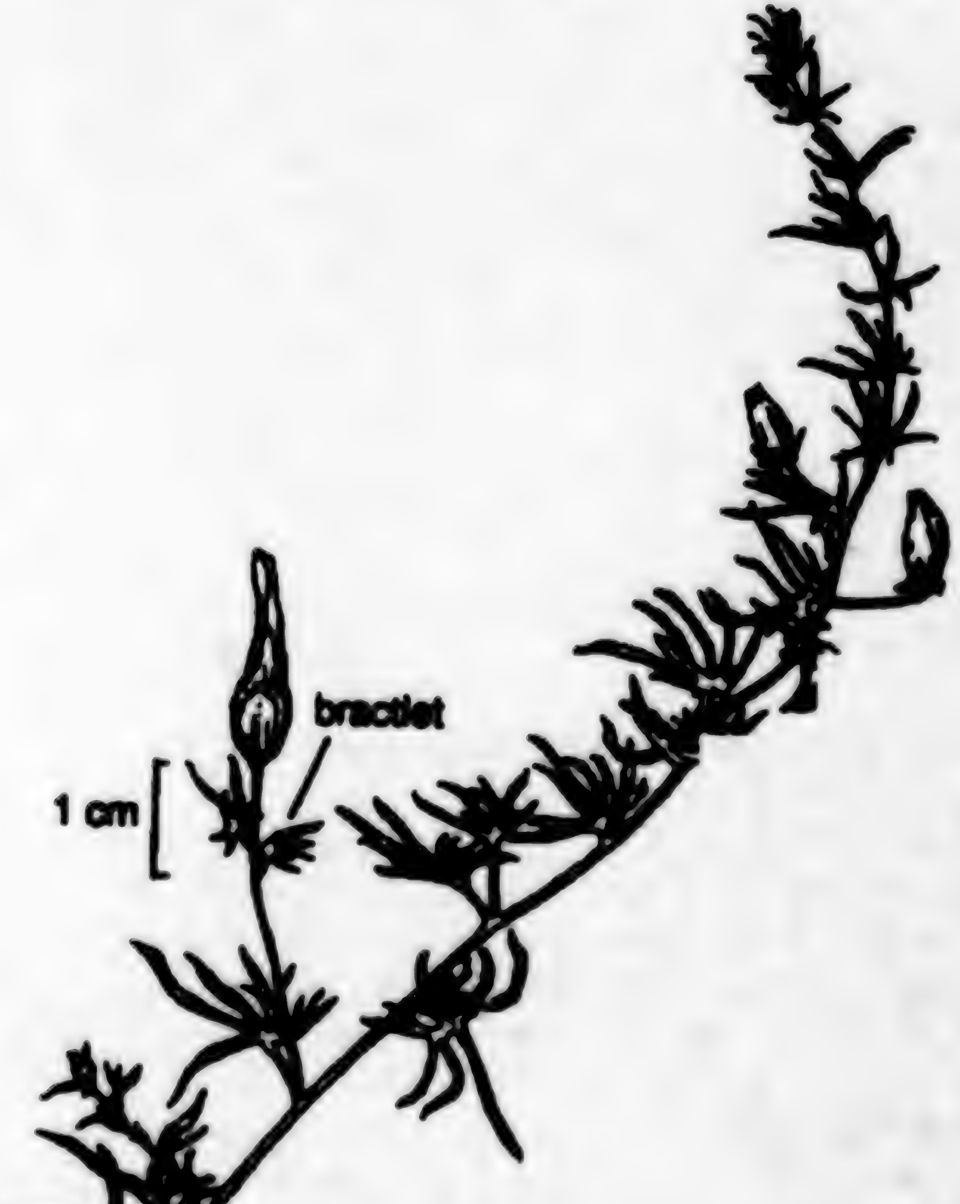

Figure II-2. Illustration of Stebbins' Morning-glory (*Calystegia stebbinsii*) (from Hickman 1993, with permission).

27

distinguished from other California morning-glories by its distinctively shaped leaves, each having 7 to 9 narrow lance-shaped lobes.

Historical and Current Distribution - *Calystegia stebbinsii* occurs in two localized areas. Most occurrences of *C. stebbinsii* are discontinuously scattered within two population centers in the northern and southern portions of the Pine Hill formation (Figure II-3). An occurrence is defined by the California Natural Diversity Database as a location separated from other locations of the species by at least one-fourth mile; an occurrence may contain one or more populations. *Calystegia stebbinsii* does not occur at the center of the formation on Pine Hill. In 1991, it was discovered in Nevada County near the County landfill, where it was sparsely scattered over a distance of 6.5 kilometers (3.5 miles) (California Natural Diversity Database 1998). *Calystegia stebbinsii* in El Dorado County is associated with chaparral on gabbroic soils. It occurs within openings within chaparral associated with *Arctostaphylos viscida* (whiteleaf manzanita). In Nevada County it occurs on serpentine in chaparral associated with *Adenostoma fasciculatum* (chamise), *Arctostaphylos* sp. (manzanita), and *Pinus sabiniana* (foothill pine) (California Natural Diversity Database 1998).

2. Pine Hill Ceanothus (*Ceanothus roderickii*)

Taxonomy - Beecher Crampton first collected *Ceanothus roderickii* (Pine Hill ceanothus) in 1956 from Pine Hill in El Dorado County, California on June 1, 1956. The type specimen for *Ceanothus roderickii* was collected from "approximately 3 miles west of Shingle Springs, California" by Walter and Irja Knight. Walter Knight described *C. roderickii* in 1968, naming it after Wayne Roderick, who first suspected the horticultural value of this endemic shrub (Knight 1968). Walter Knight (1968) considered *C. roderickii* to be most closely related to *C. cuneatus* (buckbrush), which also grows throughout the area. *Ceanothus roderickii* is suggested to resemble the sprawling *C. fresnensis* (Fresno mat) which grows a considerable distance to the south at higher elevations (plants of the two species grown in a regional park flowered at different times) (Knight 1968). *Ceanothus cuneatus* (buckbrush), *C. intergerrimus* (deerbrush), *C. lemmonii* (Lemmon's ceanothus), *C. leucodermis* (chaparral whitethorn), and *C. palmeri* (Palmer ceanothus) also occur on the Pine Hill gabbro complex and in

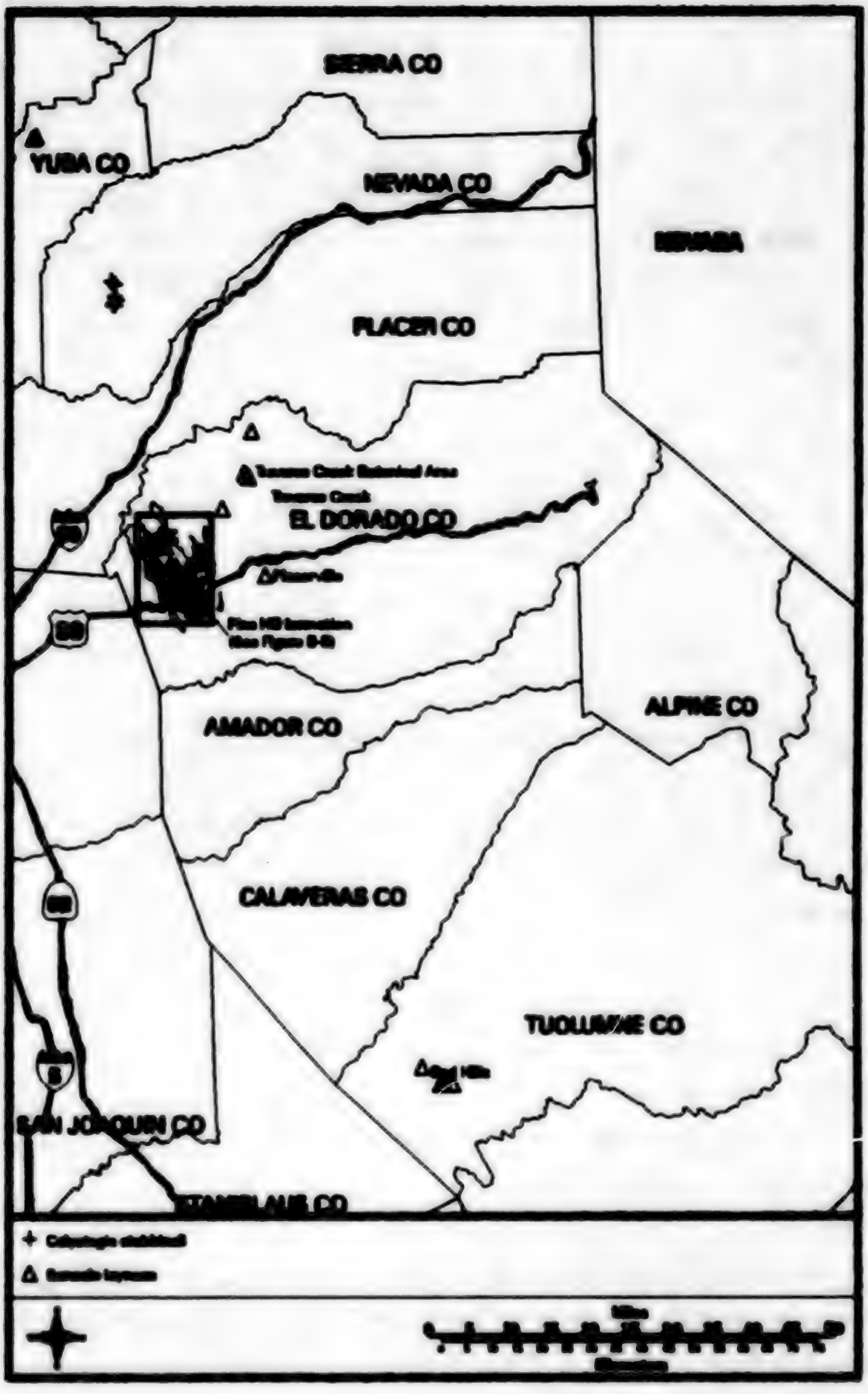

Figure II-3. Distribution of *Calystegia stebbinsii* and *Senecio layneae*.

the surrounding area (Wilson 1986). *Ceanothus roderickii* can be differentiated from its congeners (other species of the same genus, other related species) by its blue-tinged flowers, prostrate habit, and inconspicuously horned fruit.

Description - *Ceanothus roderickii* (Figure II-4) is a prostrate evergreen shrub of the buckthorn family (Rhamnaceae) that generally grows to 3 meters (9.84 feet) in diameter. The smooth gray-brown branches radiate from a central axis and root when they come into contact with the ground. Its leaves are semi-erect with entire margins. Small whitish flowers tinged with blue appear from May through June. Its fruit is an inconspicuously horned globe-shaped capsule.

Historical and Current Distribution - *Ceanothus roderickii* is restricted to gabbro soil in openings in chaparral or more infrequently on previously disturbed sites within chaparral (Wilson 1986). It is restricted to one localized area of approximately 10 known extant occurrences discontinuously scattered in the Pine Hill formation (California Natural Diversity Database 1998) (Figure II-5).

3. Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*)

Beecher Crampton made the first collection of *Fremontodendron californicum* ssp. *decumbens* in 1956. Robert M. Lloyd (1965) described *F. californicum* ssp. *decumbens* as *F. decumbens* based on the type specimen Lloyd collected in May 1964 from "California, El Dorado Co., Pine Hill, ca. 3 kilometers north of Rescue." Munz (1968) reduced *F. decumbens* to a subspecies of *F. californicum*. Kelman (1991), in his revision of *Fremontodendron*, recognized *F. californicum* ssp. *decumbens* as a full species based upon morphological variation. This taxon currently is known as *Fremontodendron californicum* ssp. *decumbens* (Whetstone and Atkinson 1993).

Description - *Fremontodendron californicum* ssp. *decumbens* (Figure II-6) is a branched spreading shrub of the cacao family (Sterculiaceae) growing to 1.3 meters (4 feet) tall. Dense star-shaped hairs cover the leaves and the younger twigs and branchlets. Its leaves are elliptic-ovate to ovate, shallowly or deeply palmately lobed with 5 to 7 lobes. *Fremontodendron californicum* ssp.

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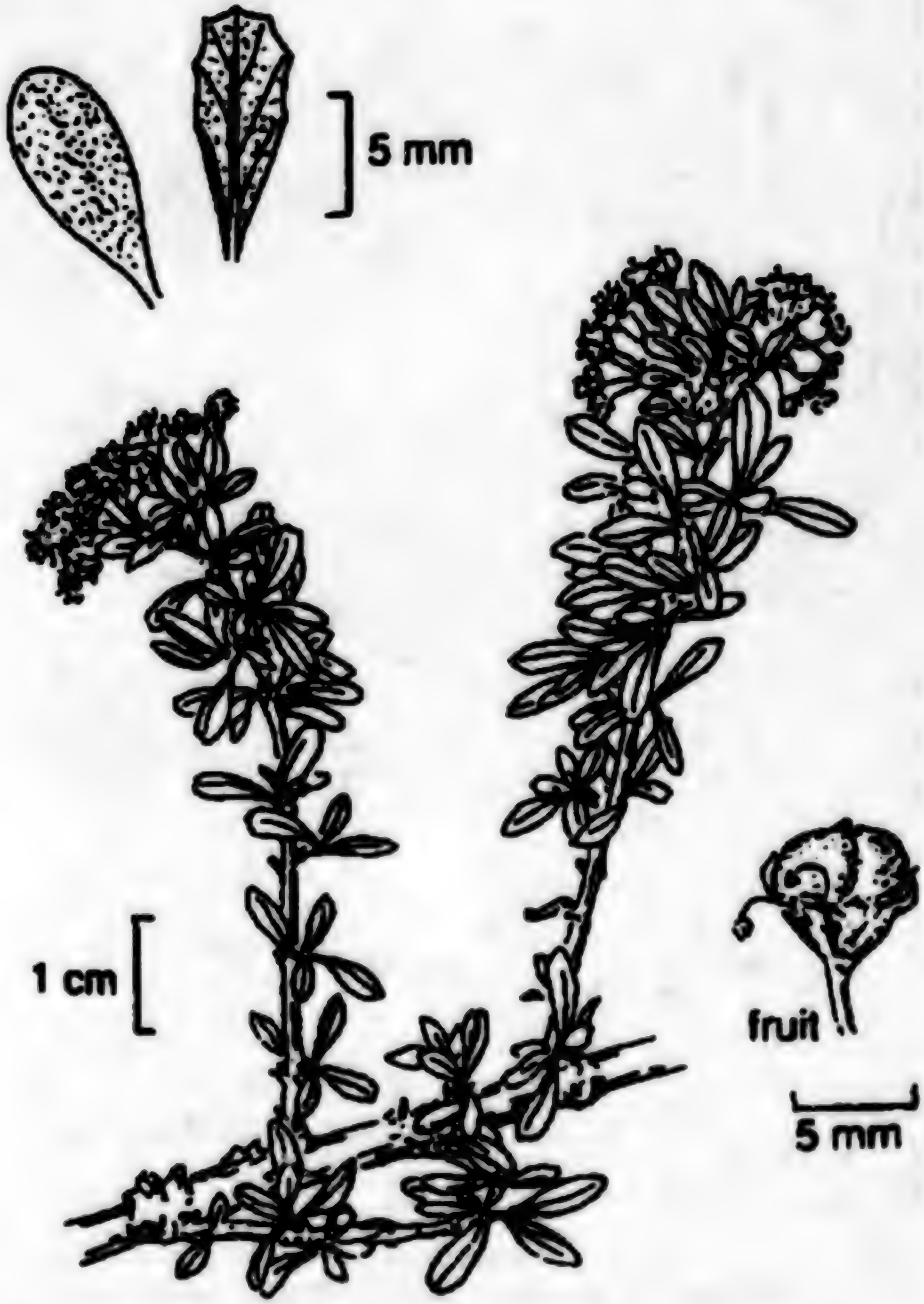

Figure II-4. Illustration of Pine Hill Ceanothus (*Ceanothus roderickii*) (from Hickman 1993, with permission).

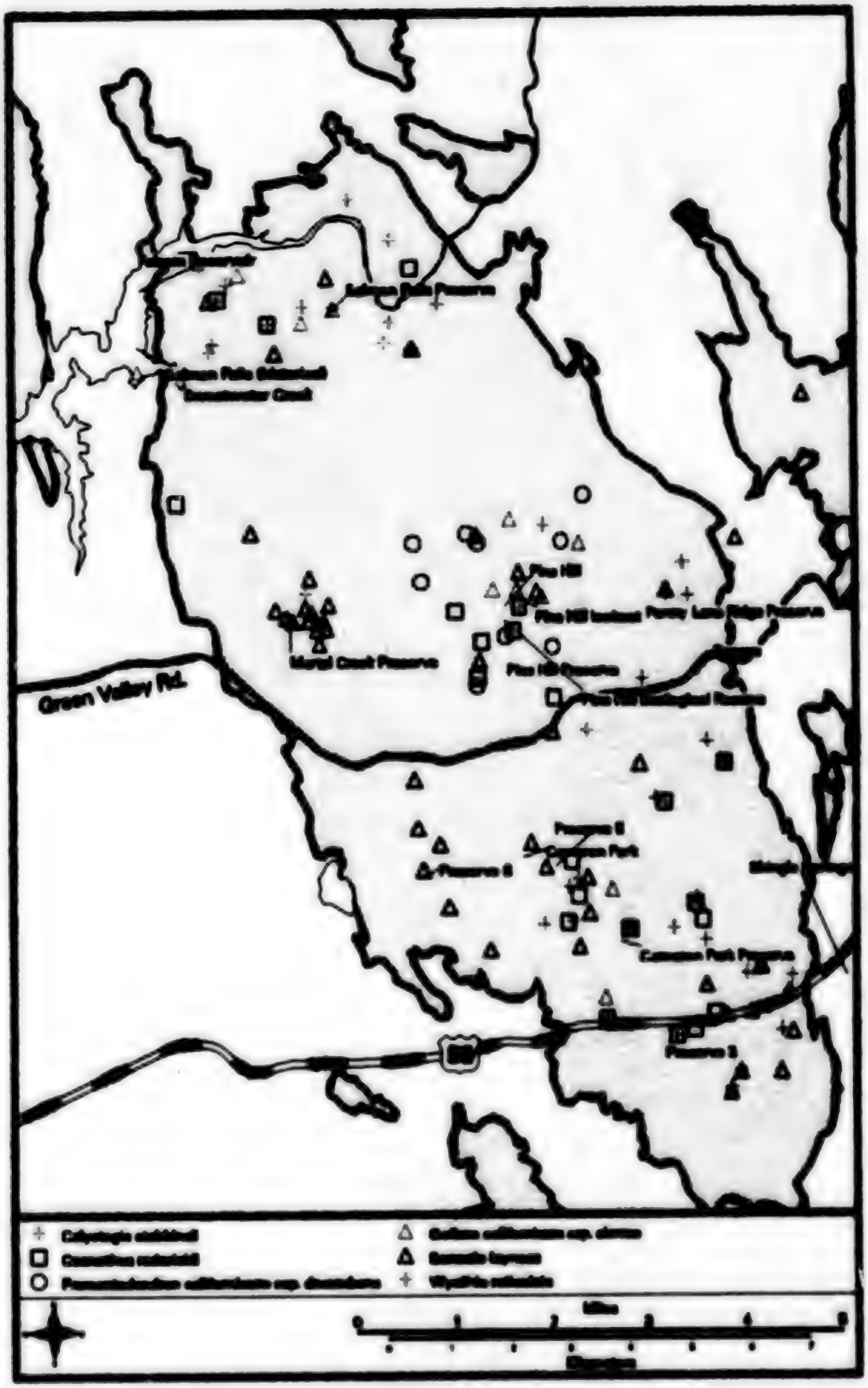

Figure II-5. Distribution of gabbro plants on the Pine Hill formation.

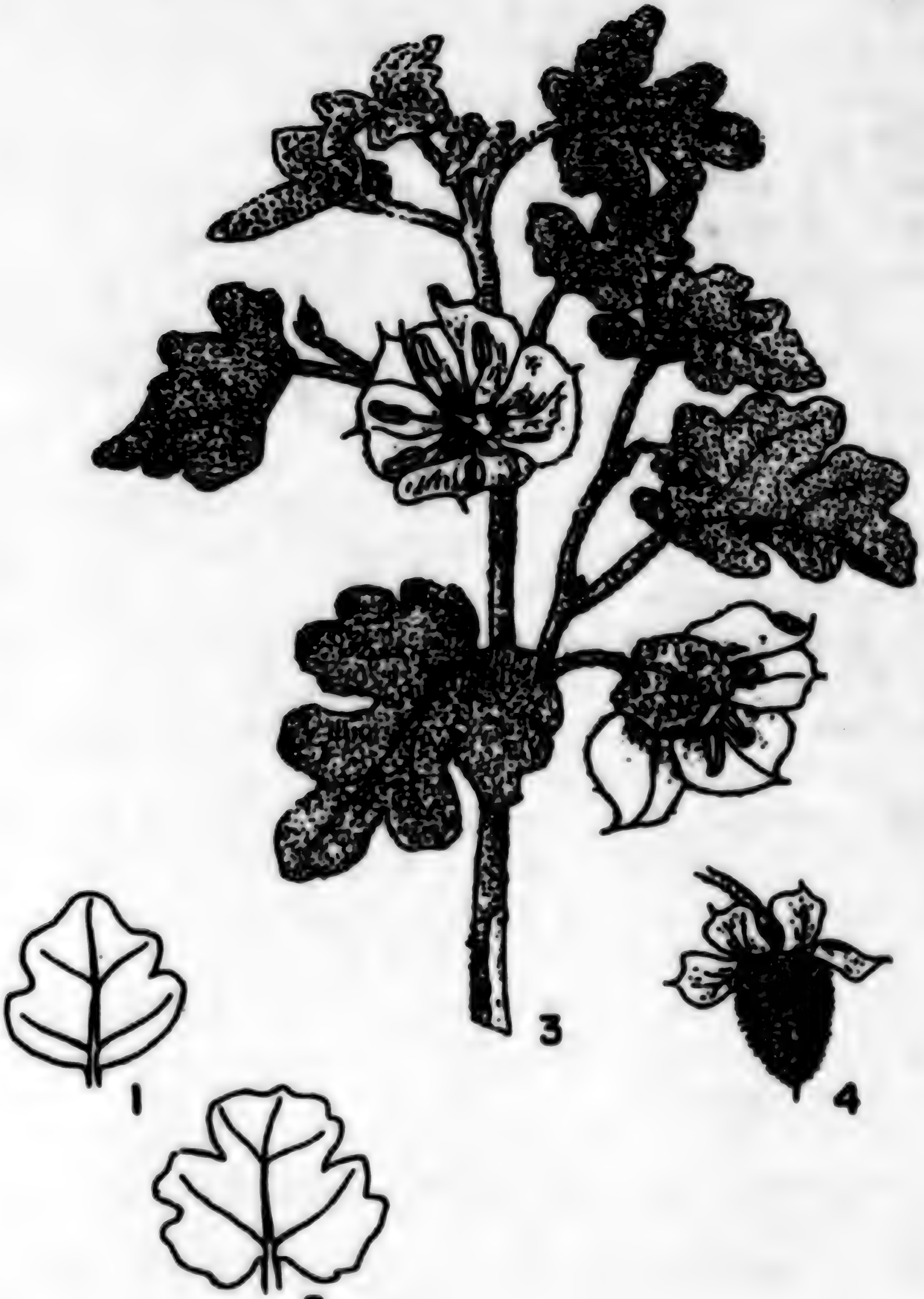

Figure II-6. Illustration of Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*) (from Lloyd 1965, with permission).

decumbens produces flower buds in late winter. Showy light-orange to reddish-brown flowers appear from late April to early July. Flowers are pollinated by solitary bees and seed dispersal is by harvester ants (Boyd 1996). Its fruit is a capsule. *Fremontodendron californicum* ssp. *decumbens* can be distinguished from *F. californicum* ssp. *californicum* and *F. mexicanum* (Mexican flannelbush) by its decumbent (stems lying on the ground and growing upward only at the tip) growth habit, its relatively long peduncles (stalks that support the inflorescence), and its copper-orange flowers.

Historical and Current Distribution - *Fremontodendron californicum* ssp. *decumbens* occurs on scattered rocky outcrops either in chaparral or in the ecotone between woodland and chaparral. It is only known from one localized area near Pine Hill in western El Dorado County scattered within an area of approximately 2,000 hectares (5,000 acres) (Figure II-5). Although there are some reports of *F. californicum* ssp. *decumbens* occurring in some small scattered populations in Yuba or Nevada County, other reports describe these individuals as aberrant *F. californicum* ssp. *californicum* (California flannelbush). *Fremontodendron californicum* ssp. *decumbens* occurs primarily on private land, but one site is on Bureau of Land Management land. *Fremontodendron californicum* ssp. *decumbens* occurs at "the ecotone between open woodland-chaparral and pine woodland." Community associates are *Pinus ponderosa* (Ponderosa pine), *P. sabiniana* (Foothill pine), *Adenostoma fasciculatum* (chamise), *Heteromeles arbutifolia* (toyon), and *Arctostaphylos glauca* (bigberry manzanita) (Kelman 1991, Boyd 1996). Presently, the Pine Hill Ecological Reserve, managed by the California Department of Fish and Game, has the largest occurrence of *F. californicum* ssp. *decumbens*.

4. El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*)

Taxonomy -The type specimen for *Galium californicum* ssp. *sierrae* was collected 1.7 kilometers (1 mile) north of Pine Hill Lookout in western El Dorado County, California. Dempster and Stebbins (1968) described *G. californicum* ssp. *sierrae*.

Description - *Galium californicum* ssp. *sierrae* (Figure II-7) is a softly

34

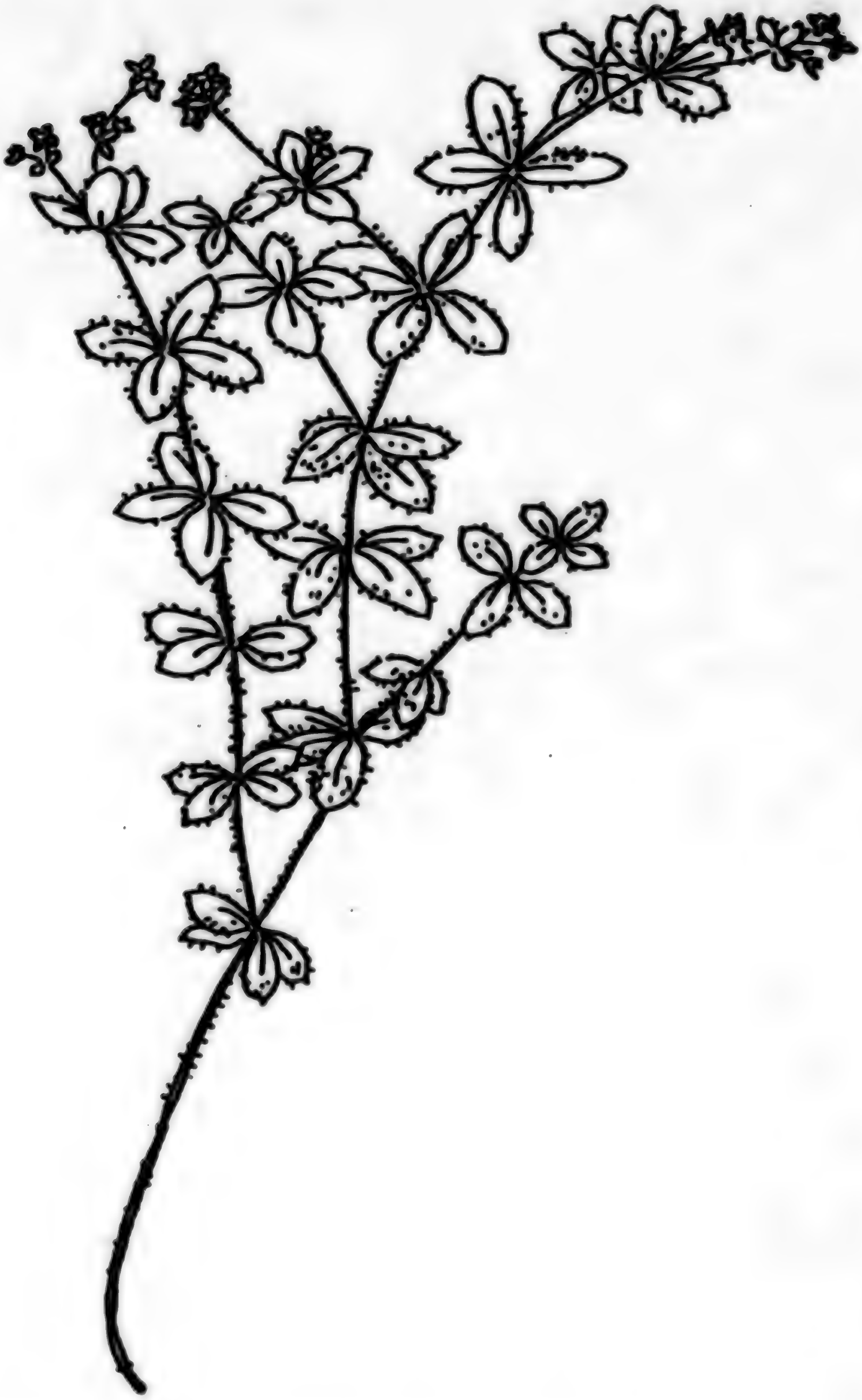

Figure II-7. Illustration of El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*) (from Dempster and Stebbins 1968, with permission).

hairy perennial herb in the coffee family (Rubiaceae). Four narrow leaves are arranged at each node. The pale yellow flowers, which are clustered at the tips of stems, appear in May and June. Minute hairs cover the fleshy fruit. *Galium aparine* (stickywilly), *G. bolanderi* (Bolander's bedstraw), *G. divericatum* (Lamarck's bedstraw), *G. porrigens* var. *tenue* (graceful bedstraw), *G. parisiense* (wall bedstraw), and *G. pubens* (limestone bedstraw) also occur on gabbro related soils in the Pine Hill area (Wilson 1986). *Galium californicum* ssp. *sierrae* is not easily confused with any other species of *Galium* (Dempster 1977) and can be distinguished from other subspecies of *G. californicum* by its very narrow leaves.

Historical and Current Distribution - *Galium californicum* ssp. *sierrae* is restricted to one localized area-- Pine Hill and surrounding ridges to the west within a distance of approximately 4 kilometers (2.5 miles) (Baad and Hanna 1987) (Figure II-5). It inhabits oak woodland areas, including sites with *Pinus ponderosa* (ponderosa pine) and *Pinus sabiniana* (foothill pine) (Wilson 1986). *Galium californicum* ssp. *sierrae* occurs primarily on private land. The Bureau of Land Management manages at least one population, and it is not clear whether another existing population occurs on Bureau of Land Management land or on private land. The California Department of Forestry and California Department of Fish and Game manage one site as well.

5. Layne's Butterweed (*Senecio layneae*)

Taxonomy - Kate Layne-Curran collected the type specimen for *Senecio layneae* in May 1883 from El Dorado County, California, on Sweetwater Creek, not far from Folsom. Edward L. Greene first described *S. layneae* in 1883 (Greene 1883). Although Asa Gray reduced *S. layneae* to a variety of *S. fastigiatus* (1884), it currently is known as *S. layneae* (Barkley 1993). *Senecio layneae* is a member of the aureoid group of *Senecio* that is united by most of the following characters: perennial herbs arising from creeping rootstocks or a stout caudex; well developed basal leaves with cauline (arising from the upper part of the stem) leaves progressively reduced upward; leaf margins without callose denticles (hard teeth); thin branching fibrous roots; and haploid chromosome numbers 22 or 23, or derived from this (Barkley 1988). The aureoid senecios are now known by some as the genus *Packera*. The type population is now thought to be extirpated due to inundation by Folsom Lake.

Description - *Senecio layneae* (Figure II-8) is a perennial herb of the aster family (Asteraceae) that sprouts from a rootstock. Its mostly basal lance-shaped leaves are 8 to 24 centimeters (3 to 10 inches) long. The several flower heads are 4 to 6 centimeters (2 to 3 inches) wide. Each flower head has 5 to 8 orange-yellow ray flowers (the flowers usually located on the edge of the inflorescence of members of the aster family) and numerous yellow disk flowers (flowers in the center portion of an inflorescence of a member of the aster family). *Senecio layneae* flowers between April and June. *Senecio aronicoides* (rayless groundsel), *S. douglasii* (Douglas' groundsel), and *S. vulgaris* (common groundsel) also occur on gabbro related soils in the Pine Hill area (Wilson 1986).

Historical and Current Distribution - *Senecio layneae* grows in open rocky areas within chaparral plant communities, primarily on gabbro soil formations and occasionally on serpentine soils. Most known sites are scattered within a 16,200-hectare (40,000-acre) area in western El Dorado County that includes the Pine Hill formation and adjacent serpentine (Figure II-3). A few other colonies occur in the Eldorado National Forest in El Dorado County, in the Bureau of Land Management Red Hills Management Area in Tuolumne County, and on Bureau of Land Management managed land in Yuba County (BioSystems Analysis, Inc. 1984, A. Franklin pers. comm. 1997) (Figure II-2). *Senecio layneae* primarily occurs on privately owned land. One site on the Pine Hill formation is managed by the California Department of Forestry and California Department of Fish and Game; two sites on the Pine Hill formation are managed by the Bureau of Land Management (California Natural Diversity Database 1998). At Traverse Creek on the Eldorado National Forest, *Senecio layneae* occurs on serpentine within chaparral associated with *Ceanothus cuneatus* (buckbrush), *Quercus dumosa* (blue oak), and *Pinus sabiniana* (Foothill pine) (California Natural Diversity Database 1998). In other parts of the National Forest, *S. layneae* is also associated with *Umbellularia californica* (California bay).

6. El Dorado Mule-ears (*Wyethia reticulata*)

Taxonomy - Kate Layne-Curran collected the type specimen for *Wyethia*

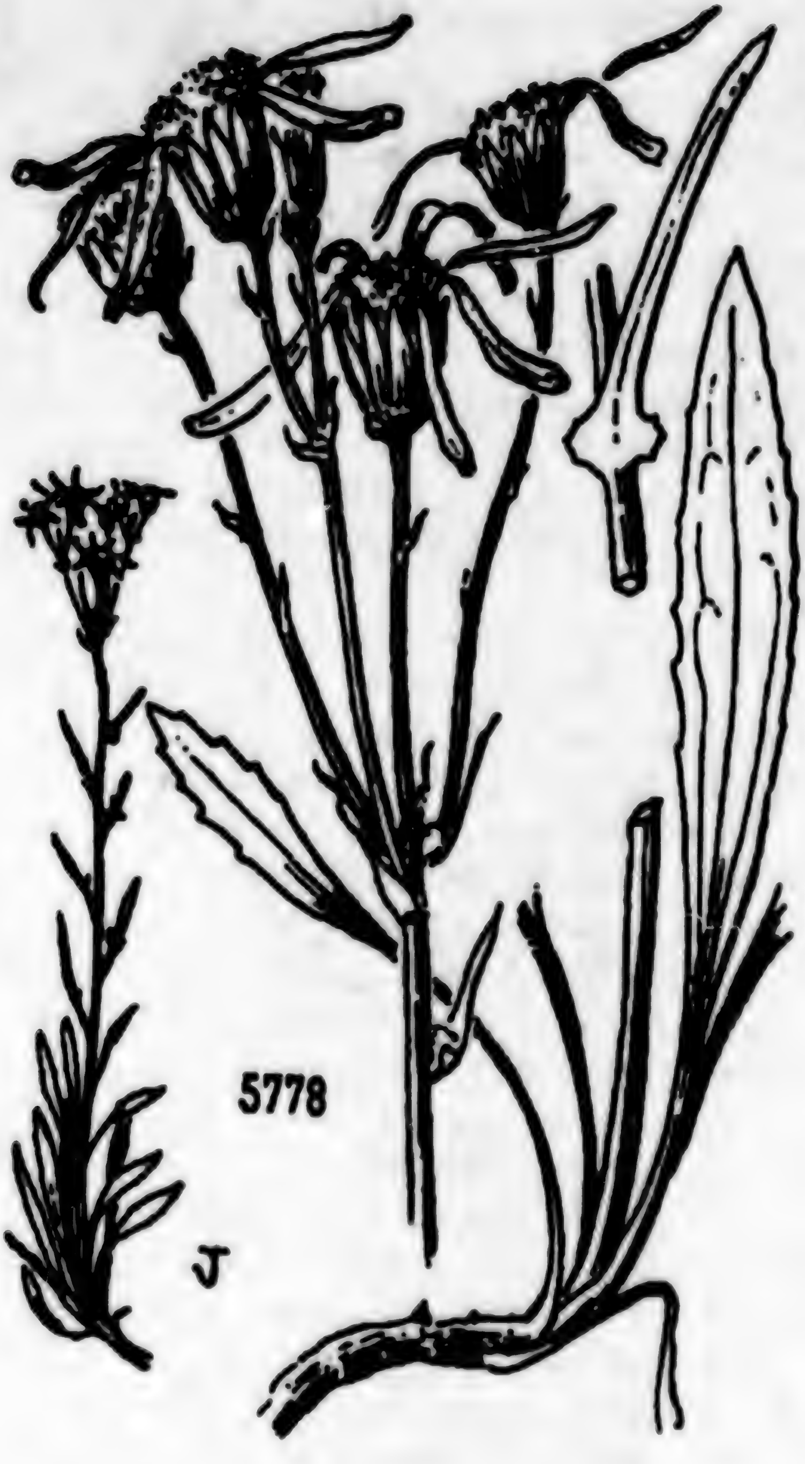

Figure II-8. Illustration of Layne's Butterweed (*Senecio layneae*) (from Abrams and Ferris 1960, with permission).

reticulata in July 1883 from "Sweetwater Creek," El Dorado County, California. Edward L. Greene first described *W. reticulata* in 1884 (Greene 1884).

Description - *Wyethia reticulata* (Figure II-9) is a clonal perennial in the aster family (Asteraceae) that grows to 1 meter tall (3.3 feet). *Wyethia reticulata* spreads extensively by underground rhizomes and has populations dominated by a few large individuals (Ayres and Ryan 1995, 1997*a*). Its leaves are cauline, ovate lanceolate to deltoid (triangular); the largest are 5 to 20 centimeters (2 to 8 inches) long and 8 to 12 centimeters (3 to 4.5 inches) wide. The one to four flower heads are 2.5 to 4 centimeters (1 to 1.6 inches) wide. *Wyethia reticulata* flowers late in the spring, is pollinated chiefly by native bees, and is self-incompatible (not capable of self-pollination) (D. Ayres pers. comm. 1998). The fruits (achenes) are dispersed by gravity. *Wyethia angustifolia* (California compassplant), *W. boldanderi* (Bolander's mulesears), and *W. helenioides* (whitehead wyethia) also occur on gabbro related soils in the Pine Hill area (Wilson 1986). *Wyethia reticulata* can be differentiated from other *Wyethia* that occur in the area by its cauline, deltoid leaves (Wilson 1986).

Historical and Current Distribution - *Wyethia reticulata* is restricted to the Pine Hill gabbro formation in western El Dorado County where it grows in open rocky areas within chaparral plant communities on gabbro soil formations (Figure II-5). Sites are patchily distributed within the chaparral community (Ayres and Ryan 1997*b*). *Wyethia reticulata* primarily occurs on privately owned land. Some populations of *W. reticulata* also occur on Federal land managed by the Bureau of Land Management. One site is on land managed by the California Department of Forestry and California Department of Fish and Game. *Wyethia reticulata* occurs on chaparral, cismontane woodland, and lower montane coniferous forest on stony red clay and gabbroic soils at 370 to 460 meters (1,200 to 1,500 feet) (California Natural Diversity Database 1998).

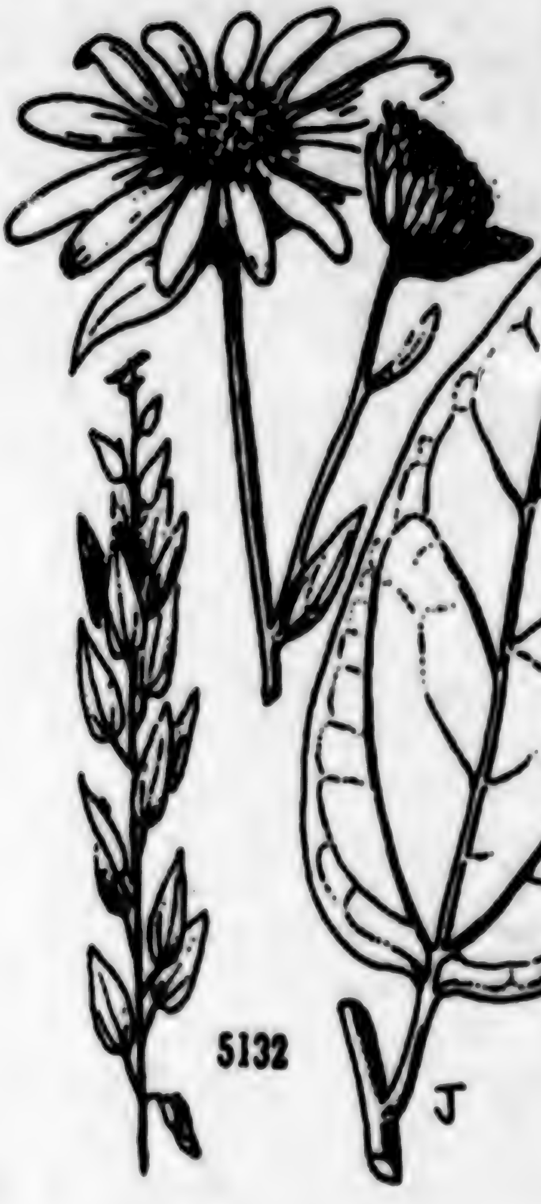

Figure II-9. Illustration of El Dorado Mule-ears (*Wyethia reticulata*) (from Abrams and Ferris 1960, with permission).

50

B. Demography And Ecology

1. Stebbins' Morning-glory (*Calystegia stebbinsii*)

Calystegia stebbinsii is a perennial herb that flowers from May through June. *Calystegia stebbinsii* appears to emerge from a dormant seed bank or rootstock after disturbance. The plants grow, begin to flower in the year following germination or re-emergence, live for several years, and re-establish a seedbank before disappearing (Nosal 1997). *Calystegia stebbinsii* seems to be intolerant of a closed canopy of vegetation (Baad and Hanna 1987).

Nosal (1997) studied *Calystegia stebbinsii* focusing on seed germination requirements, pollination, and reproductive potential. His study was conducted at three sites--two in El Dorado County (near Shingle Springs and Salmon Falls) and one in Nevada County near Grass Valley (Nosal 1997).

To study germination requirements, *Calystegia stebbinsii* seeds were tested to find out their response to scarification (cutting or abrasion), heat, and cold stratification treatments. Substrates used included potting soil, charred wood, Secca series soils, and Rescue series soil. Seeds germinated readily only after either scarification or heat treatments. Treatments using cold stratification, charred wood, Secca series soils (the type of soil at the Nevada County location), and Rescue series soils (the type of soil at the El Dorado County locations) resulted in 0 to 5 percent germination rates. Scarification resulted in 100 percent, and heat treatment 81 percent, germination rates (Nosal 1997).

Pollination studies showed that animal vectors were needed for successful seed set. None of the bagged flower buds produced fruit. Seed set in unbagged plants varied from 25 percent at Grass Valley to 50 percent at Salmon Falls and 65 percent in Shingle Springs. Observations showed that *Calystegia stebbinsii* is only pollinated by insects. Eighty percent of all visits were made by Hymenopterons, the Halictidae (solitary bees) and Apidae (honey bees) being the most important families (Nosal 1997).

At each site, data on the number of flowering plants, number of non-

41

flowering plants, number of stems per flowering plant, and number of seed capsules produced on stems within each plot sampled was collected. Seed production ranged from an average of 20.6 seeds per square meter (1.9 seeds per square foot) at Grass Valley to 380 seeds per square meter (35.3 seeds per square foot) at Salmon Falls. Plant density ranged from an average of 1.09 plants per square meter (0.10 plant per square foot) at Grass Valley to 12.1 plants per square meter (1.1 plants per square foot) at Salmon Falls. The average number of stems per plant ranged from 1.59 to 2.07. Recruitment (the number of non-flowering plants) varied from 0.038 plants per square meter (0.0035 plant per square foot) per year at Grass Valley to 0.97 plants per square meter (0.09 plant per square foot) per year at Shingle Springs (Nosal 1997).

Troutwine (1996) conducted a preliminary electrophoretic study of the genetic diversity among and within three populations of *Calystegia stebbinsii*. The genetic diversity of *Calystegia stebbinsii* also was compared with two common species, *Calystegia occidentalis* ssp. *occidentalis* (western morning-glory) and *Convolvulus arvensis* (common field bindweed). Samples of leaf tissue of *Calystegia stebbinsii* were obtained from three sites--two in El Dorado County (near Shingle Springs and Salmon Falls) and one in Nevada County near Grass Valley. The preliminary data showed no evolutionary difference among the three *Calystegia stebbinsii* populations. The study focused on four enzyme systems and a more detailed study is needed (Troutwine 1996).

2. Pine Hill Ceanothus (*Ceanothus roderickii*)

Ceanothus roderickii is a shrub that flowers from May to June. It does not resprout from its crown after a fire as do some other chaparral shrub species, and therefore depends on reestablishment from seeds after a fire. After a fire, *Ceanothus roderickii* sprouts and proliferates before the formation of overgrowth from *Arctostaphylos viscida* (whiteleaf manzanita) and *Adenostoma fasciculatum* (chamise) (James 1996). Other obligate seeding *Ceanothus* species need to be about 25 years old for enough seeds to be in the seedbank (V. Parker pers. comm. 1998). If fire occurs at too frequent an interval, there may not be a seedbank to replenish this plant from. Reported population sizes vary from 3 plants to over 1,000 plants (California Natural Diversity Database 1998). No information is known about the genetic structure (i.e., which populations are most genetically diverse or variable) of this plant species.

James (1996) conducted a demographic and ecological study of *Ceanothus roderickii* focusing on germination requirements, pollination biology, and reproductive potential. His study was conducted at sites near Shingle Springs, Cameron Park, and Pine Hill on the Pine Hill formation.

One-year old and 2-year old *Ceanothus roderickii* seeds were subjected to a variety of hot and cold treatments and lighting conditions to determine the effect on seed germination from the treatments. Little or no gemination was observed in the heat treated or control seeds. The seeds treated with a combination of heat and cold had the best germination rate (86.6 percent germination). Seeds treated by subjecting to only a cold treatment had a 20 percent germination rate. One-year old seeds germinated at a rate significantly lower than 2-year old seeds (James 1996).

Pollination studies showed that animal pollinators were required for reproductive success. The pollination of *Ceanothus roderickii* is primarily by insects from the orders Diptera (flies and gnats) and Hymentoptera (bees and wasps). The pollinators were not specific only to *Ceanothus roderickii*, but were observed visiting other plants (James 1996).

The effects of shading by canopy species on the reproductive potential of *Ceanothus roderickii* were studied on the south and east facing slopes of Pine Hill on the Pine Hill formation in western El Dorado County. One focus of the study was to determine whether there might be a decrease in the reproductive potential of *Ceanothus roderickii* as time passes after a fire or other disturbance from shading by other canopy species. Canopy shading was shown to affect flower and fruit production in *Ceanothus roderickii*. The highest flower and fruit production was correlated with high solar intensity in the morning. No correlation existed with high intensity afternoon solar intensity and increased flower or fruit production (James 1996).

3. Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*)

Fremontodendron californicum ssp. *decumbens* is a perennial shrub that flowers from late April to early July (California Native Plant Society 1994). Boyd (1996) summarized the ecological life cycle of *Fremontodendron californicum* ssp. *decumbens*. Plants start producing flower buds in late winter. By the time the flowers open most of the flower buds have been destroyed (Boyd and Serafini 1992). Native solitary bees pollinate the flowers (Boyd 1994, 1996). Seventy percent of the developing fruit is destroyed by insects prior to maturing. The remaining fruit dehisces (opens up) during summer and releases seeds into the soil. The seeds are eaten by rodents and dispersed by harvester ants (Boyd 1996). The total number of individuals of *Fremontodendron californicum* ssp. *decumbens* is about 500 (Horenstein and Ehrgott 1997).

Boyd and Serafini (1992) studied predehiscence attrition (loss of flower buds, flowers, and immature fruits prior to the fruit opening); postdehiscence attrition (seed predation); seed germination; seed longevity; seed establishment and survival; and population structure of *Fremontodendron californicum* ssp. *decumbens*. In studying reproductive attrition (decrease in the number of reproductive structures, flowers, fruits, seeds), Boyd and Serafini (1992) found the production of seeds in *Fremontodendron californicum* ssp. *decumbens* was severely limited by insect predation. Less than 2 percent of flower buds produced fruit because of predation by insects. In addition, rodents destroyed 90 percent of seeds under shrubs within 8 to 10 months (Boyd and Serafini 1992). Additionally, Boyd and Serafini (1992) found that *F. californicum* ssp. *decumbens* cannot reproduce sexually without fire. They concluded that to maintain genetic diversity and establish plants at new localities within the boundaries of the current populations, sexual reproduction may be necessary over long time periods.

Effects on seed germination of scarification by heat or mechanical methods, stratification, inhibitors in the seed coat, and the presence of *Adenostoma fasciculatum* (chamise) were examined (Boyd and Serafini 1992). Seven treatments were made: (1) no treatment; (2) stratifying seeds at 5 degrees Centigrade (41 degrees Fahrenheit) for 3 weeks; (3) scarifying seeds by rubbing them on sand paper; (4) scarifying and stratifying the seeds (a combination of treatments 2 and 3); (5) removing the seed coat completely; (6) heating the seeds at 100 degrees Centigrade (212 degrees Fahrenheit) for 5 minutes; and (7) heating the seeds as in treatment 6, but then planting the seeds in ash from *Adenostoma fasciculatum* (chamise). Treatments that disturbed the seed coat (scarifying, heating) increased germination rates 18 to 26-fold over untreated seeds. The highest germination rate, 72.2 percent, was obtained when heat treated seeds were planted in ash from *Adenostoma fasciculatum* (chamise) (Boyd and Serafini 1992).

Two experiments on seed longevity of *Fremontodendron californicum* ssp. *decumbens* were performed (Boyd and Serafini 1992). One set of experiments used plants from the University of California Davis's arboretum; the second set used plants from Pine Hill. In the first experiment, seeds from *Fremontodendron californicum* ssp. *decumbens* arboretum plants were put in sleeves and covered with mesh cloth (to protect them from predation by rodents), placed on the soil surface, and covered with leaf litter in 1982. The sleeves were recovered in June 1989 and the number of intact seeds was counted and seed viability of any remaining seeds was checked. In the second experiment, seeds from dehisced fruit and seed bank seeds (older seeds from the soil) around the *Fremontodendron californicum* ssp. *decumbens* plants on Pine Hill were used. The seeds were set out in the field in 1983, in a similar manner as the first experiments, and recovered in 1989. Again, the intact seeds and seed viability were checked. The viability of the arboretum seeds after nearly 7 years was 96 percent. The survival rates of the fresh and seed bank seeds from Pine Hill were not significantly different from each other (about 83 percent).

In studying seedling establishment and survival, Boyd and Serafini (1992) found that none of the 12 natural seedlings that were found, nor the seedlings that were planted in pots, survived. Most of the seedlings were destroyed by predators. Those that had escaped predation eventually died from drought.

Fremontodendron californicum ssp. *decumbens* plants at two sites on Pine Hill were mapped and measured to determine population structure (Boyd and Serafini 1992). Site 1 shrubs were mapped in 1982 and measured in 1986. Site 2 shrubs were mapped and measured in February 1984. Both sites contained a large

45

proportion of small sized shrubs. Almost all of the shrubs were multi-stemmed. Some of the small shrubs were associated with recent human disturbance (Boyd and Serafini 1992).

Boyd (1994) studied pollination biology of *Fremontodendron californicum* ssp. *decumbens*. Basic information on importance of floral visitors to seed production, limitations to reproduction from pollen, and behavior of floral visitors was obtained. Studies showed that insects were required for pollination. Almost all of the floral visits were made by native solitary bees. The primary floral visitor to the flowers was *Tetralonia stretchii* (anthrophorid bee) (89.4 percent of the visits). The second floral visitor in importance (8.7 percent of the visits) was *Callanthidium illustre* (megachilid bee) (Boyd 1994). Hand pollination did not increase the amount of fruit set, but almost doubled the number of seeds per fruit (Boyd 1994). Studies on seed dispersal for *Fremontodendron californicum* ssp. *decumbens* documented that seeds were dispersed by *Messor andrei* (harvester ants). Seeds were carried up to 12 meters (39 feet) from the *Fremontodendron californicum* ssp. *decumbens* shrubs (Boyd 1996).

4. El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*)

Galium californicum ssp. *sierrae* is a perennial herb flowering from May to June (California Native Plant Society 1994). Two occurrences had population range figures recorded. One occurrence had about 50 plants, the other from 11 to 50 plants (California Natural Diversity Database 1998). Very little is known about the biology or ecology of *Galium californicum* ssp. *sierrae* (California Department of Fish and Game 1992). Details of the reproductive biology and demography of the species are not available.

5. Layne's Butterweed (*Senecio layneae*)

Senecio layneae is a perennial herb that flowers from April to July (California Native Plant Society 1994). Population figures for occurrences vary from 10 to over 1,000 individuals (California Natural Diversity Database 1998). Initial observations show *Senecio layneae* appears to be an early successional species that occupies temporary openings on gabbro or serpentine and is eliminated as vegetation grows up around it (Baad and Hanna 1987). Details of the reproductive biology and demography of this species are not available.

6. El Dorado Mule-ears (*Wyethia reticulata*)

Wyethia reticulata is a clonal species that can grow to be very large and old, with some individuals estimated to be 1,000 years old. *Wyethia reticulata* flowers late in the spring, is pollinated chiefly by native bees, and is self-incompatible (Ayres and Ryan 1997). Recruitment from seed is very poor in *Wyethia reticulata*.

The genetic structure and spatial pattern of genetic variation of *Wyethia reticulata* was studied from four sites on the Pine Hill formation: Cameron Park, Rescue, and two sites at the northern part of the species range in Salmon Falls (Ayres and Ryan 1997*b*). Large stands of plants that were 250 to 360 square meters (2,690 to 3,875 square feet) were found to have few genetic individuals. Additionally, *Wyethia reticulata* was found to be highly genetically diverse, with most of the genetic diversity occurring within populations (Ayres and Ryan 1997*b*).

7. Fire Ecology

Boyd (1987) conducted a study in 1983 on the effects of controlled burning on *Fremontodendron californicum* ssp. *decumbens*, *Ceanothus roderickii*, and *Wyethia reticulata*. Boyd found that each of the three species was adapted to naturally occurring fires and required fire to stimulate reproduction. *Fremontodendron californicum* ssp. *decumbens* produced additional individuals by fire stimulated germination of the seed bank and production of sprouts from the roots of established plants (Boyd 1987). The proportion of rootsprouts on mature individuals was significantly higher in the burned area than in the unburned area.

Ceanothus roderickii does not resprout from its crown after a fire as do some other chaparral shrub species, and therefore depends on reestablishment from seeds. The burned plots and the unburned plots in Boyd's study were similar in the number of plants present before the controlled burn, yet none of the mature

Ceanothus roderickii resprouted following the controlled burn (Boyd 1987). A 22-fold difference in seedling production was observed the spring following the controlled burn (Boyd 1987). Additionally, the survival of the burned plot seedlings of *Ceanothus roderickii* was significantly greater than that of the unburned plots at all census times during the 3-year study.

Wyethia reticulata was not harmed by the controlled burn and has fire stimulated flowering. Although it does not need fire to stimulate the seed bank, plants reproduced vegetatively the second season after a controlled burn and had 7.5 times the number of flowering heads (Boyd 1985).

C. Reasons For Decline and Threats To Survival

Historically, gold rush activities and clearing for agriculture reduced and fragmented habitat in western El Dorado County. More recently, vegetation on the Pine Hill formation has changed significantly due to commercial and residential development, road construction, and fragmentation. Between 1960 and 1990, the human population in El Dorado County increased 428 percent (California Department of Finance 1998). Nearly 23 percent of the gabbro formation is urbanized (Horenstein unpublished data 1994). Commercial or residential developments have partially or completely destroyed occurrences of all of the species (California Natural Diversity Database 1998, California Department of Fish and Game 1990*a*, California Department of Fish and Game 1990*b*, G. Clark *in litt.* 1993).

Urbanization, including habitat loss, habitat fragmentation, alteration of natural fire regime, and suppression of disturbance, is the major threat facing *Calystegia stebbinsii*, *Ceanothus roderickii*, *Fremontodendron californicum* ssp. *decumbens*, *Galium californicum* ssp. *[illegible]rae*, *Senecio layneae*, and *Wyethia reticulata*. Proposed residential or commercial development within the Pine Hill formation, combined with growth induced by proposed dams on the South Fork of the American River, threaten most of the sites within the Pine Hill formation and adjacent serpentine in western El Dorado County, and will adversely impact most of the range of all six taxa. Nearly all the remaining occurrences of all of these species are threatened by destruction of habitat through residential or commercial

48

development. El Dorado County, which has a projected population growth of 54 percent between 1990 and 2005, is one of the most rapidly growing counties in California (California Department of Finance 1991, Jones and Stokes Associates 1992). In 1991, the population grew by 4.2 percent, a rate that is faster than the projected growth rate of 3.6 percent (California Department of Finance 1992). Western El Dorado County is becoming a bedroom community as it is easily accessible by freeway from several nearby cities including Sacramento. Most of the new residential growth in El Dorado County is expected to occur within western El Dorado County near Highway 50 (Jones and Stokes Associates 1992), which crosses the southern portion of the Pine Hill formation.

The subsequent induced growth would affect all six species in both the northern and southern portions of the Pine Hill formation and adjacent serpentine, either by further fragmenting the habitat (as discussed below) or by directly destroying habitat. The increasing number of people and changes in land uses will continue to place an increasing strain on undeveloped areas through activities such as off-road vehicle traffic, unauthorized garbage dumping, and changes in the pattern of wildfires.

The effects of residential and commercial activities extend beyond direct impacts to habitat. Habitat fragmentation and edge effects significantly impact gabbro plants. Habitat fragments may be too small to protect from being burned all at once. Additionally, habitat fragments may be too small to support viable populations of animals serving as pollinators or seed dispersal agents for the endangered plant taxa. Animals may be unable to move among isolated habitats, potentially resulting in the loss of these species from habitat fragments. Such effects at the scale of individual populations can cumulatively result in local extirpation or extinction of an entire taxon. Hunter and Horenstein (1991) characterized vegetation structure on the Pine Hill formation and estimated the median patch size to be only 11 hectares (27 acres). This degree of fragmentation is significant within chaparral because plant species will disappear from fragments between 10 and 100 hectares (25 to 250 acres) in size due to persistent disturbance and potentially due to change in fire frequency (Soulé *et al.* 1992).

Edge effects, a corollary of habitat fragmentation occur at the interfaces of any two or more habitat types, but are more pronounced for natural communities bordered by human disturbances. Edge effects reduce the integrity of a site as habitat fragments get smaller. Fragmentation splits habitat into smaller, more isolated units and has two primary effects. First, habitat fragmentation may alter the physical environment, changing the amount of incoming solar radiation, water, wind, or nutrients for the remnant vegetation (Saunders *et al.* 1991). Second, most of these fragmented natural areas are subject to influences from external factors (e.g., additional development, lawn and garden watering, herbicide drift, and off-road vehicular use) that disrupt natural ecosystem processes. Current and future land use changes such as commercial and residential development and road construction continue the habitat fragmentation process.

Changes in fire frequency threaten *Calystegia stebbinsii*, *Ceanothus roderickii*, *Fremontodendron californicum* ssp. *decumbens*, *Senecio layneae*, and *Wyethia reticulata*. These plants occur within a fire-adapted plant community, either within chaparral or on the ecotone between chaparral and woodland. Fire suppression policies have altered natural processes within several plant communities in California. Historically, fire occurred in chaparral on the average of three to five times every 100 years (Boyd 1985). Excessive fire frequency also potentially threatens *Ceanothus roderickii* and *Fremontodendron californicum* ssp. *decumbens*. These plants need sufficient time between burns to set enough seed to replenish the soil seedbank. Mature plants of *F. californicum* ssp. *decumbens* also need to build up carbohydrate reserves to be able to resprout after a fire (Boyd 1985).

Mitigation for development often is by small "set asides" (small natural areas within the development), which increase habitat fragmentation, are difficult to manage for fire, and are subject to edge effect problems. Land development and multiple ownership complicate the planning and implementation of controlled burns at the appropriate fire frequency necessary for maintenance of chaparral. Limited suitable "pristine" habitat is left for a preserve system especially in the southern portion of the range (within the Pine Hill formation). Twelve potential preserve sites were identified as the best remaining habitat for the five federally listed plants on the Pine Hill formation and adjacent serpentine (EIP Associates 1991). Within these 12 sites, at least 11 residential or commercial projects have been proposed (Appendix B).

Lesser threats include road widening and maintenance, off-road vehicle use, garbage dumping, horse paddocking, mining, competition with invasive non-native vegetation, and other human-caused conditions associated with increased development. These activities variously threaten individual occurrences of some of these species within their respective ranges.

Road widening occurs near development within El Dorado County, and this activity is known to have extirpated one occurrence of *Senecio layneae* and threatens an additional five sites (California Natural Diversity Database 1994). Road-widening also threatens the habitat of *Ceanothus roderickii* at one site (California Natural Diversity Database 1994). Road maintenance and herbicide spraying potentially threaten another site of *Calystegia stebbinsii* that occurs along a road cut (California Natural Diversity Database 1994). One occurrence was adversely affected by grading. Off-road vehicle use has adversely affected the habitat of *Calystegia stebbinsii* at one site (California Natural Diversity Database 1994) and the habitat of *Ceanothus roderickii* at three sites in the northern part of the Pine Hill formation. Several hills are scarred with off-road vehicle tracks. Erosion promoted by scarring adversely modifies the habitat. Intensive off-road vehicle use threatens two occurrences of *Senecio layneae* (California Natural Diversity Database 1994). One site of *S. layneae* in the northern part of the Pine Hill formation is affected by heavy off-road vehicle use and has been fragmented by the many roads that traverse the entire area. A southern site of *S. layneae* that occurs across 89 hectares (221 acres) was graded and grubbed in preparation for development and is subject to off-road vehicle use over part of the site (California Natural Diversity Database 1994).

Habitat degradation from garbage dumping on ridge-tops around Pine Hill degrades the habitat and is a minor threat to *Fremontodendron californicum* ssp. *decumbens* (J. Wilson pers. comm. 1993).

Horse paddocking in rural residential areas within the middle and northern portions of the Pine Hill formation threaten *Calystegia stebbinsii*, *Galium californicum* ssp. *sierrae*, and *Senecio layneae*. The horses, when confined, severely graze most available vegetation. The herbaceous gabbro plants are especially likely to be grazed (J. Van Ess pers. comm. 1993).

Three known occurrences of *Senecio layneae* are found on the Eldorado National Forest in El Dorado County. A fourth occurrence was extirpated by rural development in 1994. Human related activities that have or may impact the three remaining occurrences include road maintenance and construction, mining, powerline maintenance, and recreation activities (D. Rodriguez *in litt.* 1998). Habitat for *Senecio layneae* within the Traverse Creek Botanical Area in the Eldorado National Forest historically was fragmented by serpentine quarrying (M. Foster pers. comm. 1993). Although commercial claims have been withdrawn, recreational mining for semiprecious stones and gold still occurs at the Traverse Creek Botanical Area on the Eldorado National Forest (D. Rodriguez pers. comm. 1998).

Activities often associated with rural residential areas, such as clearing chaparral for fire protection around houses, bulldozing land (grading for houses or barns), planting fruit trees, and irrigation also have modified the habitat within western El Dorado County (J. Jokerst, pers. comm. 1993, J. Van Ess pers. comm. 1993). The ongoing repetitive clearing of chaparral destroys the habitat. Irrigation involved with lawn maintenance also adversely affects these species (J. Van Ess pers. comm. 1993, J. Jokerst pers. comm. 1993).

D. Conservation Efforts

Attempts to set up an ecological reserve have been ongoing for more than 20 years. In the fall of 1977, the California Native Plant Society learned of plans to dispose of surplus California Department of Forestry lands located on Pine Hill in El Dorado County (Howard 1979). Beginning in late fall of 1977, the California Native Plant Society united with other environmental groups to encourage the State of California to begin a coordinated effort to preserve significant natural areas. Through 1978 and into 1979, a multi-constituent committee, including the California Native Plant Society, Audubon Society, and California Resources Agency, met to set up a significant natural area for Pine Hill. Pine Hill Ecological Reserve (97 hectares [240 acres]) was established in 1979 to

57

protect the gabbro plants located on the summit of Pine Hill.

The State of California listed *Fremontodendron californicum* ssp. *decumbens*, *Galium californicum* ssp. *sierrae*, and *Senecio layneae* as rare in 1979. *Calystegia stebbinsii* was listed as endangered by the State of California in 1981 and *Ceanothus roderickii* was listed as rare in 1982 (California Department of Fish and Game 1992). In 1987, a management plan was written for the Pine Hill Ecological Reserve (Baad and Hanna 1987).

In 1992, the California Department of Fish and Game, Bureau of Land Management, and Bureau of Reclamation signed a memorandum of understanding to protect the gabbro plant habitat along the South Fork of the American River (California Department of Fish and Game 1992).

In the late 1980's, the California Department of Fish and Game brought to the attention of El Dorado County that many of the development projects in western El Dorado County would likely have significant direct or cumulative effects on eight rare plant species (Economic & Planning Systems, Inc. 1997). Private developers and El Dorado County contracted a report to determine potential preserve sites.

The California Natural Diversity Data Base, James Wilson's masters thesis (1986), survey reports prepared by environmental consultants, interviews with local botanists, and EIP Associates' field surveys were used to determine location of clusters of rare plants occurring on the Pine Hill formation (EIP Associates 1991). Twenty-two clusters of rare plant species were initially identified. Ten of these sites were rejected after review of additional data and aerial photographs because they had been developed.

The criteria used to rank the potential preserves included: the number of target species present; the abundance of each target species present; the area of the potential preserve; the distance from the boundary of the potential preserve to target species; preserve shape; condition of the site; presence of managed natural areas near the site; presence of rare plants on more than one soil type within the potential preserve site; and/or presence of plants thought to be gabbro endemics

63

on nongabbro soil (EIP Associates 1991). This study, completed in November 1991, identified 12 potential preserve sites (EIP Associates 1991) (Table II-3).

In 1992, El Dorado County held public workshops concerning this report. A Rare Plant Advisory Committee, consisting of 10 members from the development community, various agencies (California Department of Fish and Game, Bureau of Land Management, U.S. Fish and Wildlife Service), El Dorado County planning staff, California Native Plant Society, American River Conservancy, and others, was established to identify feasible preserve sites, funding mechanisms, and management strategies for these preserves.

The Rare Plant Advisory Committee recommended three main preserve sites--Salmon Falls, Pine Hill, and Cameron Park/Shingle Springs--and two smaller satellite preserve areas--Martel Creek and Penny Lane. The total acreage of the five preserves that the Rare Plant Advisory Committee proposed was 1,416.6 hectares (3,500 acres) (Table II-4, Figure II-10). Five preserve sites were identified to protect more than one population of each species, to protect against catastrophic loss at any one site, maintain genetic diversity within the rare plant species, and preserve a representation of the geographic range, diversity of plant associations, and other potentially important site-specific conditions associated with the rare plants (Horenstein and Erhgott 1997). Mechanisms identified to acquire the Salmon Falls preserve, Pine Hill preserve, and Cameron Park/Shingle Springs preserve were density transfers, sales or donations of easements by willing parties, and purchase of land, respectively (Appendix C). The recommendations of the Rare Plant Advisory Committee were presented to the El Dorado County Board of Supervisors in February 1993. The Board of Supervisors approved, in concept, four of the preserves, but eliminated the large Cameron Park southern preserve site. At that point, the Board of Supervisors would not consider local funding for financing the acquisition or maintenance of the preserve system.

During meetings held for technical review of the U.S. Fish and Wildlife Service's draft critical needs plan from the February 27, 1995 biological opinion for Central Valley Project Interim Water Contract renewals, invited experts recommended all five of the preserves identified by the Rare Plant Advisory

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Table II-3. Summary of potential preserve sites on the Pine Hill formation (EIP Associates 1991).

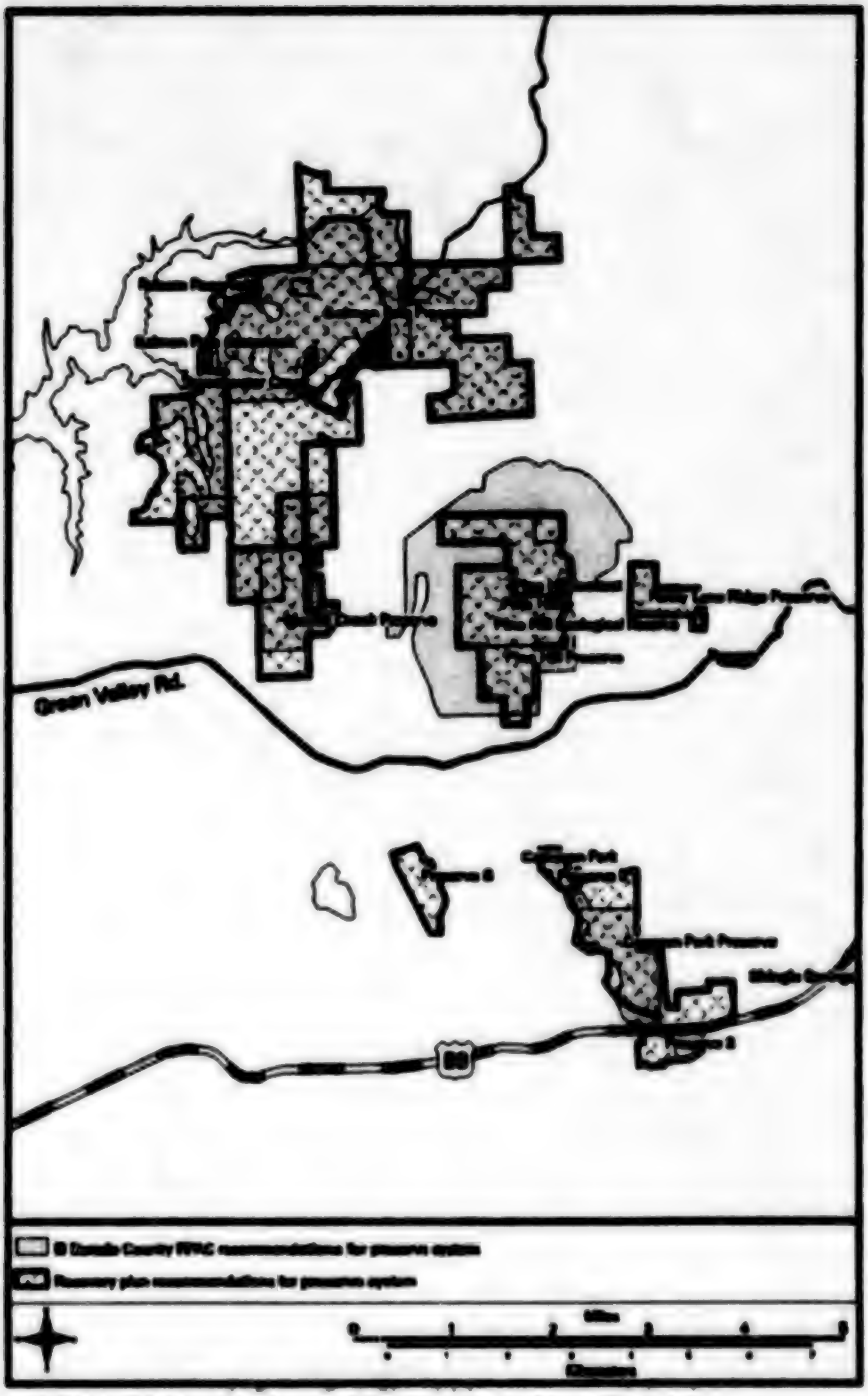
Preserve number	Total score	Size in hectares	Size in acres	Public land	Locality	Calystegia stebbinsii	Ceanothus roderickii	Galium californicum ssp. sierrae	Fremontodendron californicum ssp. decumbens	Senecio laynese	Wyethia reticulata
1	11	25.33	62.6	none	Southern					+*	+*
2	6-7	29.9	73.88	none	Southern	+++++				++	
3	21	44.66	110.37	partly County	Southern	++++*				++	+
4	56-58	>258.07	>637.68	none	Southern	+++++	++++	++++		+++	++
5	33	29.5	72.9	none	Southern		++++			++	+
6	9	>61	>150	none	Southern					++	
7	34	+/- 72.85	+/- 180	none	Middle		++++			+++	++
8	14-16	8.1	20	part BLM	Middle					+	+
9	16-26	>125.9	>311.2	part BLM	Middle			?		?	++
10	22	212.26	524.49	none	Northern						++
11	79-81	606.37	1498.33	40 acre CDFG	Northern	+++++	++++	++++		++*	++
12	39-41	299	738.7	part BLM	Northern			++*	++*	+	

The number of "+" represents a relative abundance for each species; *= ½+; S = Southern (South of Green Valley Road); N =Northern - North of Sweetwater Creek; M= Middle Pine Hill area- North of Green Valley Road, South of Sweetwater Creek; BLM=Bureau of Land Management; CDFG= California Department of Fish and Game, > means " greater than"; +/- means "about".

Table II-4 - El Dorado County Rare Plant Advisory Committee recommendations for the preserve system.

Proposed Preserve	**Recommended Preserve Size**	**Land Publicly held or Acquired as of April 1998**
Salmon Falls	714.4 hectares (1,765 acres)	265.5 hectares (656 acres) (123.8 hectares (306 acres) CDFG, 141.6 hectares (350 acres) BLM)
Pine Hill	283.3 hectares (700 acres)	145.7 hectares (360 acres) (97.1 hectares (240 acres) CDFG, 32.4 hectares (80 acres) CDF, 16.2 hectares (40 acres) BLM)
Martel Creek	161.9 hectares (400 acres)	81 hectares (200 acres)
BLM Satellite Site (Penny Lane Ridge)	74.9 hectares (185 acres)	74.9 hectares (185 acres)
Cameron Park	182.1 hectares (450 acres)	47.3 hectares (117 acres)
Total	1,416.6 hectares (3,500 acres)	614.4 hectares (1,518 acres)

BLM- Bureau of Land Management
CDFG- California Department of Fish and Game
CDF- California Department of Forestry


Green Valley Rd.
50
El Dorado County RPAC recommendations for preserve system
Recovery plan recommendations for preserve system
Miles
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4
5
Kilometers

Figure II-10. El Dorado County Rare Plant Advisory Committee recommendations for preserve system and recovery plan recommendations for preserve system on the Pine Hill formation.

Committee as the critical need for the five federally listed gabbro species (which were proposed at the time of the meeting). A critical need was defined as those actions needed immediately to avoid extinction or preclusion of recovery.

On October 18, 1996, *Calystegia stebbinsii*, *Ceanothus roderickii*, *Fremontodendron californicum* ssp. *decumbens*, and *Galium californicum* ssp. *sierrae* were federally listed as endangered, and *Senecio layneae* was federally listed as threatened (U. S. Fish and Wildlife Service 1996).

Since 1993, attempts have been made by the American River Conservancy and California Department of Fish and Game to obtain funding for the preserves through the Land and Water Conservation Fund and by a ballot bond proposition. Attempts at obtaining either of these funding sources have so far been unsuccessful. In 1993 and in 1996, the American River Conservancy proposed a multi-agency funding program with funds coming from: (1) the El Dorado Irrigation District (with repayment through a water meter and delivery surcharge); (2) the Bureau of Reclamation's Central Valley Project Improvement Act (b)(1) other program; (3) development impact fees collected by the El Dorado Planning Department; (4) the Bureau of Land Management through a land exchange program; (5) the Wildlife Conservation Board through specific funding authorizations; and (6) grant funding through the Environmental Enhancement and Mitigation Program and the Habitat Conservation Program administered by the State of California (Horenstein and Ehrgott 1997).

In 1993, the California Department of Fish and Game applied for and received a section 6 grant from the U.S. Fish and Wildlife Service for investigating funding mechanisms for land acquisition. A draft economic feasibility study for acquiring the rare plant preserves, prepared by Economic & Planning Systems, Inc., was published in 1997.

From 1990 to the present, additional habitat has been acquired to contribute to the reserve system. In 1990, the Wildlife Conservation Board approved the purchase of an additional 16.2-hectare (40-acre) parcel near Salmon Falls with Proposition 70 funds. An additional 16.2 hectares (40 acres) were acquired in the Salmon Falls area in 1991 using Proposition 117 funds (California

Department of Fish and Game 1992).

The American River Conservancy and California Department of Fish and Game submitted a proposal in February 1997, requesting $1.5 million from the Central Valley Project Improvement Act (b)(1) other program to assist in the acquisition of 127.5 hectares (315 acres) of the Cameron Park preserve, in three phases. One million dollars of Central Valley Project Improvement Act funds were granted and used in conjunction with $1,786,000 from the El Dorado Irrigation District and El Dorado County, and $100,000 from the National Fish and Wildlife Foundation for the first phase of the purchase of the Cameron Park Preserve. Phases 2 and 3 are scheduled to close escrow in fiscal year 1999. Funding for the second two phases is proposed to come from the following sources:

Phase 2 **25.5 hectares (63 acres) - Part 1**

Central Valley Project Improvement Act Restoration Fund	$ 500,000
El Dorado County	$ 500,000
El Dorado Irrigation District	$ 500,000
TOTAL Phase 2 - Part 1	$ 1,500,000

36.4 hectares (90 acres) - Part 2

Funding sources yet to be determined.

Phase 3 **18.2 hectares (45 acres)**

Bureau of Land Management	$1,071,000

III. RECOVERY

A. Objectives

The overall objective of this recovery plan is to delist the five federally listed species and ensure the long-term conservation of *Wyethia reticulata*, a species of concern covered in the plan. Interim goals include (1) stabilizing and protecting populations, (2) conducting research necessary to refine reclassification and recovery criteria, and (3) reclassifying to threatened (downlisting) species currently federally listed as endangered. Reclassification is appropriate when a taxon is no longer in danger of extinction throughout a significant portion of its range. Because data upon which to base decisions about reclassification and recovery are mostly lacking, downlisting and recovery criteria in this plan are necessarily preliminary.

1. Multispecies strategy

Recovery and long-term conservation tasks emphasized in this plan are (1) habitat protection and management, (2) surveying and monitoring, (3) research, and (4) public participation, outreach, and education. Specifics of each strategy are given in this chapter and in the Stepdown Narrative (Chapter IV).

All species covered in the plan are threatened by loss of gabbro habitat and by fragmentation of the few remaining larger blocks of gabbro habitat in western El Dorado County. Therefore, the highest priority task for recovery is the protection of areas currently or potentially occupied by the species. High priority protection areas are areas currently occupied by, or providing potential habitat for, several species covered in the plan, and (2) areas that are currently occupied by, or providing potential habitat for, only a single species covered in the plan. Areas to be protected for single species include those occupied by populations considered important within the species range (e.g., populations at the edge of the range or populations that may provide genetic variation).

The areas identified by the Rare Plant Advisory Committee are the highest priority protection areas, because they have several species and contain the most occurrences in the least fragmented areas remaining within the three zones or areas on the Pine Hill formation. Within these identified areas, populations on private land should be protected by land acquisition, conservation easements, or other means. For populations on public land, protection will require that the California Department of Fish and Game and the Bureau of Land Management prepare and implement management plans to ensure the long-term survival of the species on their lands. However, the preserve system recommended by the Rare Plant Advisory Committee is not adequate to achieve recovery of some target species. Even if all five preserve areas identified by the Rare Plant Advisory Committee are protected, more than 50 percent of the plant occurrences would be lost, including occurrences that are essential to the recovery of three of the five listed gabbro species. Additional preserves will be necessary to recover *Galium californicum* ssp. *sierrae*, *Calystegia stebbinsii*, and *Ceanothus roderickii*. Wherever possible, protection should first focus on larger blocks of land and on publicly owned lands. However, because gabbro habitat is naturally and artificially limited in area and patchy in distribution, some smaller parcels and cooperation from private individuals and entities will be necessary to ensure recovery and long-term conservation of the species covered in the plan. Cooperation may involve selling of land, selling or granting of easements, or voluntary cooperation in programs to maintain and/or enhance habitat values for gabbro species.

Another high priority recovery action is the development and implementation of sound management plans for protected gabbro lands. The plans should include provisions for fire management and standardized monitoring. In many cases, effective habitat management and [illegible]ion techniques are undeveloped for species covered in the plan [illegible]fore, management must be "adaptive" or flexible based on new data, research, or observed outcomes of ongoing management. Fire management is a high priority management strategy for all of the preserve sites. Other potential management may include various forms of vegetation management (e.g., grazing). The impact of various strategies on individual species should be studied. Management plans should also include strategies to minimize known threats at the preserves and also to identify new threats as they may appear. If new threats are identified or other new information becomes available, management plans need to be reevaluated and revised.

Certain types of research are also high priority recovery activities for the gabbro plants. Studies determining the appropriate timing of fires (i.e., length of time between fires versus the seasonal timing) are important for management and need to be conducted. Additional high priority research includes studies on the basic ecology, reproduction, and demography of *Galium californicum* ssp. *sierrae* and *Senecio layneae*; demographic studies determining limiting life stages for *Calystegia stebbinsii*, *Ceanothus roderickii*, *Galium californicum* ssp. *sierrae*, *Senecio layneae*, and *Wyethia reticulata*; and identification of *Fremontodendron* in Nevada and Yuba Counties.

Activities of lower priority include surveys of potential habitat for all species covered in the recovery plan. Surveys of other serpentine and gabbro habitat within the range of *Senecio layneae* should be conducted to determine if undiscovered populations may exist. If new populations are discovered, they should be protected and managed. Surveys should include gabbro areas (Mildred soil series) in Yuba County. Additionally, directed surveys for *Galium californicum* ssp. *sierrae* and *Calystegia stebbinsii* should be conducted.

2. Habitat considerations

Within the Pine Hill formation in western El Dorado County, the six rare gabbro plants occur in three zones or areas (see Figure I-2). Each of these three zones (north, middle, south) is considered to contain important habitat for the recovery of these species. Not all the zones, nor all the potential unfragmented habitat that could serve as preserve sites have all the species. Different complements of preserves are needed to protect each species. The goal is to have a large preserve as well as smaller non-contiguous satellite preserves in the southern and central zone, and a large preserve in the northern zone.

Many separate preserves are desirable to reduce the possibility that a natural catastrophic or human event will eliminate most or all of the populations of a species. Species protected at only a few sites are especially vulnerable to extinction from events such as repetitive fires that occur at too short an interval

62

for the plants to replenish their seedbank, insect infestations or disease, extended drought, or competition with introduced non-native vegetation.

Different populations of plants are expected to be genetically different. Genetic diversity helps a species survive changing conditions. It increases the potential that individual plants will survive some types of catastrophic events such as diseases, insect infestations, or extended drought. Having several preserves throughout the range of a species increases the probability that whatever genetic diversity a species has will be protected.

It is important to have large preserves because four of the five federally listed plants live in a fire-adapted plant community near an urban interface. A preserve needs to be large enough to make controlled fire feasible, and also large enough to minimize the possibility of the entire preserve burning at one time. Additionally, large preserves have a smaller perimeter to area ratio, which means that there is less effect to the interior of a preserve from external factors such as non-native vegetation or urban runoff. Small fragments of habitat may not maintain proper ecosystem functioning and often lose native species so the diversity of native vegetation is reduced. Factors that need to be considered in determining the appropriate size of preserves include, but are not restricted to (1) the area needed for establishment, expansion, and buffering of several subpopulations of these species within each zone they occur in; (2) the area needed to minimize edge effects from non-native plants, different environmental conditions along the edge of the management area, and chance catastrophic events; (3) the area needed to manage periodic burns for maintenance of the gabbroic mixed northern chaparral plant community; (4) the current and potential future land uses of surrounding land; (5) the shape of the preserves; and (6) the area needed to support the interactions of key community members including dispersal vectors and pollinators.

3. Individual species considerations

In El Dorado County, *Calystegia stebbinsii* occurs in two localized areas. Most occurrences of *C. stebbinsii* are discontinuously scattered within two population centers in the northern and southern portions of the Pine Hill formation. *Calystegia stebbinsii* does not occur at the center of the formation on Pine Hill. It also occurs sparsely scattered along a narrow band over a distance of approximately 2.2 kilometers (3.5 miles) in Nevada County. The goal is to protect at least five dense populations in each of at least three non-contiguous preserves or populations in the southern zone and northern zone on the Pine Hill formation. Additionally, the Nevada County occurrences should be preserved. *Calystegia stebbinsii* appears to be an early successional species that occupies temporary openings on gabbro or serpentine and is eliminated as vegetation grows up around it. Preserves should include sufficient habitat to allow for expansion or shifts in occupied habitat. Studies are needed to determine plant longevity, seed longevity, seed bank dynamics, and optimal disturbance regime for the long term viability of a population (Nosal 1997).

Ceanothus roderickii is restricted to the Pine Hill formation. It occurs on gabbro-derived soil in openings in chaparral or more infrequently on previously disturbed sites within chaparral (Wilson 1986). Known extant occurrences are discontinuously scattered in the Pine Hill formation. The goal is to protect at least five dense populations in each of at least three large non-contiguous preserves within each zone within the Pine Hill formation where this plant occurs. Research needs include studies on population size and density to determine the minimum viable population and optimal densities for stable populations. Additional research needs include studies on seed production, vegetative propagation, and cohort survivorship (James 1996).

Fremontodendron californicum ssp. *decumbens* only occurs in the central part of the Pine Hill formation within 1.25 kilometers (2 miles) of Pine Hill. Fire is needed to maintain habitat for this species. The total population is estimated to comprise only 500 individuals. The goal is to protect all of the occupied habitat on public land and 95 percent of the known occupied habitat on private land. Preservation of the pollinating fauna of native solitary bees is also important to the survival and recovery of *F. californicum* ssp. *decumbens*.

Galium californicum ssp. *sierrae* is endemic to and quite rare within the Pine Hill formation. Loss of one occurrence would result in a significant impact to its viability as a species. The goal is to protect all of the occupied habitat on

64

public land and 95 percent of each occurrence on private land.

Senecio layneae grows in open rocky areas within chaparral plant communities, primarily on gabbro-derived soils and occasionally on serpentine-derived soils. Most known sites are scattered within the Pine Hill formation and adjacent serpentine primarily on private land. A few other colonies occur in the Eldorado National Forest in El Dorado County, the Bureau of Land Management Red Hills Management Area in Tuolumne County, and on Bureau of Land Management managed land in Yuba County (BioSystems Analysis, Inc. 1984, A. Franklin pers. comm. 1997). *Senecio layneae* appears to be an early successional species that occupies temporary openings on gabbro or serpentine and is eliminated as vegetation grows up around it. Preserves should include sufficient habitat to allow for expansion or shifts in occupied habitat. The goal is to protect at least five dense populations in each of at least three non-contiguous preserves within the southern and the central zone on the Pine Hill formation; five dense populations in the preserve in the northern zone on the Pine Hill formation, as well as the adjacent unoccupied habitat that can be managed through controlled burns or disturbance to support this plant in the future. Additionally, all known populations on Bureau of Land Management and Eldorado National Forest land should be secured and protected from incompatible uses.

Wyethia reticulata grows in open rocky areas within chaparral plant communities, on gabbro-derived soils. All known sites are scattered within the Pine Hill formation. Currently, *W. reticulata* primarily occurs on privately owned land. Providing unoccupied potentially suitable habitat allows for plant succession, which is necessary for the long-term conservation of this species. *Wyethia reticulata* is a clonal species that can grow to be very large and old, with some individuals estimated to be 1,000 years old. Recruitment from seed is very poor in *Wyethia reticulata*. Therefore, *Wyethia reticulata* needs to be protected where it currently occurs. Restoration is not an appropriate strategy for this species (D. Ayres pers. comm. 1998). The goal is to protect five dense populations in each of at least three non-contiguous preserves within the southern and central zone and the large preserve in the northern zone, as well as adjacent unoccupied habitat that can be managed through controlled burns to support this plant in the future.

B. Recovery Criteria

The recommended preserve strategy for the Pine Hill formation is summarized in Table III-1. Recovery criteria for federally listed species and criteria for long-term conservation of *Wyethia reticulata* are given in Table III-2.

For each species, dense populations need to be preserved in at least two non-contiguous preserves in the southern and central zone and dense non-contiguous populations need to be preserved in the northern zone (Table III-1). Within the southern zone (Figure I-1), where there has been a significant amount of habitat fragmentation, the goal is to protect approximately 390 hectares (963 acres) of habitat in three or more preserves. The primary southern preserve should comprise approximately 255 contiguous hectares (630 contiguous acres). The other preserve(s) ideally should be at least 40 hectares (100 acres) in size. In the central zone the goal is to preserve one large preserve (340 hectares [840 acres]) surrounding Pine Hill and two satellite preserves (totaling approximately 267 hectares [660 acres]). In the northern zone, where less development has occurred and habitat is not as fragmented, the goal is to preserve approximately 1,060 hectares (2,620 acres) in a large contiguous area.

Table III-1. Sizes of preserves needed within the Pine Hill formation.

Zone	Primary Preserve Size (in hectares)	Primary Preserve Size (in acres)	Satellite Preserve(s) (in hectares)	Satellite Preserve(s) (in acres)	Total (hectares)	Total (acres)
South	255	630	135	333	390	963
Central	340	840	267	660	607	1,500
North	1,060	2,618			1,060	2,618
Total	1,655	4,088	402	993	2,057	5,081

Listed Plant Species. - In general, downlisting criteria for federally listed endangered plant species are based on (1) protection and adaptive management in perpetuity of currently known sites or habitat, (2) evidence that populations at these sites are stable or increasing over a number of years (how many years depends on the life history of the individual species and the need for fire management), (3) storage of seed in Center for Plant Conservation certified facilities, and (4) development of reliable seed germination and propagation techniques. Protection of sites should first target the lands recommended by the El Dorado Rare Plant Advisory Committee including the largest possible blocks of land and a buffer of 150 meters (500 feet). Protection should involve populations throughout the known range of the species. Populations should be monitored at appropriate time intervals. Until research shows otherwise, recovery should target securing populations containing a minimum of 40 hectares (100 acres) of habitat (but preferably more). Delisting generally involves meeting the above criteria as well as finding, repatriating, or introducing several additional populations of the species. However, because repatriation and creation of populations are expensive and experimental, surveying historical sites and potential habitat within the historical range to find currently unknown populations is the preferred strategy. Once delisting criteria have been attained, a status review must be conducted to determine whether reclassification is appropriate. *Fremontodendron californicum* ssp. *decumbens* should not be considered for delisting because it is limited to one location in an area that is extensively developed.

Plant Species of Concern. - Ensuring long-term conservation of *Wyethia reticulata* involves meeting criteria similar to those given above for reclassifying listed plant species: protection and management of known sites, evidence of stable or increasing populations over a number of years, and seed banking at Center for Plant Conservation-certified facilities. These criteria assume that long-term conservation has been achieved if populations remain throughout the historical range, are not declining, and are secure from threats.

Table III-2. Generalized recovery criteria for federally listed plants and conservation criteria for *Wyethia reticulata*. Though not explicitly stated, delisting criteria includes meeting all of the downlisting criteria.

Species	**Recovery Step**	**Secure and protect specified recovery areas from incompatible uses**	**Management plan approved and implemented for recovery areas, including survival of the species as the objective**	**Population monitoring in specified recovery areas shows:**	**Other actions**
Stebbin's Morning-glory (*Calystegia stebbinsii*)	downlist	Cameron Park Preserve; Salmon Falls Preserve; additional preserves in the southern and northern portions of the Pine Hill formation and occurrences in Nevada County along with sufficient adjacent unoccupied habitat for fire management and a 150-meter (500-foot) buffer	For all protected populations and any adjacent areas identified as essential to continued survival	Stable or increasing over one fire cycle (about 30 years) (subject to modification depending on results of fire management studies)	Fire management studies; additional research on genetics of Nevada County population; seeds of disjunct populations stored in at least two Center for Plant Conservation certified facilities
	delist		For all occurrences and any adjacent areas identified as essential to continued survival	No decline after downlisting during two additional fire cycles (about 60 years); if declining, determine cause and reverse trend	

Species	**Recovery Step**	**Secure and protect specified recovery areas from incompatible uses**	**Management plan approved and implemented for recovery areas, including survival of the species as the objective**	**Population monitoring in specified recovery areas shows:**	**Other actions**
Pine Hill Ceanothus (*Ceanothus roderickii*)	downlist	Cameron Park Preserve; Pine Hill Preserve; Salmon Falls Preserve; and additional preserves in the southern and northern portions of the Pine Hill formation along with sufficient adjacent unoccupied habitat for fire management and a 150-meter (500-foot) buffer	For preserves and any adjacent occupied or unoccupied habitat identified as essential to continued survival	Stable or increasing over one fire cycle (about 30 years) (subject to modification depending on results of fire management studies)	Fire management studies; research on genetics
	delist		For all occurrences and any adjacent areas identified as essential to continued survival	No decline after downlisting during two additional fire cycles (about 60 years); if declining, determine cause and reverse trend	

Species	Recovery Step	Secure and protect specified recovery areas from incompatible uses	Management plan approved and implemented for recovery areas, including survival of the species as the objective	Population monitoring in specified recovery areas shows:	Other actions
Pine Hill Flannelbush (*Fremontodendron californicum* ssp. *decumbens*)	downlist[1]; actions shown are to aid survival of the species	Pine Hill preserve and occupied habitat along with sufficient adjacent unoccupied habitat for fire management and a 150-meter (500-foot) buffer at 10 known sites	For all sites and any adjacent occupied or unoccupied habitat identified as essential to continued survival	Stable or increasing over 60 years (two fire cycles or longer if suggested by results of demographic monitoring)	Fire management studies; seeds stored in at least two Center for Plant Conservation certified facilities; seed germination and propagation techniques understood
El Dorado Bedstraw (*Galium californicum* ssp. *sierrae*)	downlist	Pine Hill preserve and occupied habitat along with adjacent unoccupied habitat and a 150-meter (500-foot) buffer at all known sites	For all populations and any occupied or unoccupied habitat identified as essential to survival	Stable or increasing with evidence of natural recruitment for an additional period of 60 years (or longer if suggested by the results of demographic monitoring)	Ecological studies; seeds stored in at least two Center for Plant Conservation certified facilities; seed germination and propagation techniques understood; effects of fire studied
	delist	15 occurrences representing the range of the species	For all occurrences and any adjacent areas identified as essential to continued survival	No decline after downlisting; if declining, determine cause and reverse trend	

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[1] Not to be delisted unless additional populations are found outside the Pine Hill formation.

Species	**Recovery Step**	**Secure and protect specified recovery areas from incompatible uses**	**Management plan approved and implemented for recovery areas, including survival of the species as the objective**	**Population monitoring in specified recovery areas shows:**	**Other actions**
Layne's Butterweed (*Senecio layneae*)	delist	Populations representing the range of the species including Cameron Park Preserve, Pine Hill Preserve, Martel Creek Preserve, Penny Lane Preserve, Salmon Falls Preserve, occupied habitat on BLM lands in Yuba and Tuolumne Counties, and occupied habitat on the Eldorado National Forest along with adjacent unoccupied habitat and a 150-meter (500-foot) buffer	For all populations and any occupied or unoccupied habitat identified as essential to survival	Stable or increasing with evidence of natural recruitment for a period of 60 years that includes normal disturbance	Study importance of fire for management; seeds of disjunct populations stored in at least two Center for Plant Conservation certified facilities
El Dorado Mule- ears (*Wyethia reticulata*)	conserve	Cameron Park Preserve; Pine Hill Preserve; Penny Lane Preserve; Martel Creek Preserve; Salmon Falls Preserve; additional preserves in the southern and northern portions of the Pine Hill formation along with sufficient adjacent unoccupied habitat for fire management and a 150-meter (500-foot) buffer	For all populations and any occupied or unoccupied habitat identified as essential to survival.	Stable or increasing over 60 years	

C. Recovery Priorities

Actions necessary to recover (or delist) a listed species or ensure the long-term conservation of a species of concern are ranked in three categories:

Priority 1- an action that must be taken to prevent extinction or to prevent a species from declining irreversibly in the foreseeable future.

Priority 2 - an action that must be taken to prevent a significant decline in the species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - all other actions necessary to meet recovery or conservation objectives.

Although recovery or conservation actions are often ranked for each species individually, wherever possible the plan focuses on multispecies actions. Where an action involves several species, the recovery/conservation priority reflects both the needs of individual species and the broad benefit to the group of species. Because situations change as time passes, recovery/conservation priorities must be considered in the context of what has already happened and is likely to happen at all sites. Therefore, the priorities assigned are intended to guide, not to constrain, the allocation of limited conservation resources.

IV. STEPDOWN NARRATIVE

1. Develop and implement a cooperative program and participation plan.

A cooperative program is needed to coordinate local public and private land use planning with State and Federal land use and recovery planning for gabbro species. A cooperative program needs to be developed focusing on Western El Dorado County. A participation plan produced from this program will increase the chances of recovery for listed species and ensure the long-term conservation of the species of concern covered in this plan.

1.1 Establish a cooperative program with participants from the public and private sector (Priority 2).

Interested parties in local, State and Federal government and in the private sector should be identified, and their willingness to participate in a cooperative program determined. A program should be initiated.

1.2 Develop and implement a participation plan.

A participation plan should include (1) outreach to enhance public understanding of rare species in general and of gabbro endemic species in particular, and (2) economic incentives for conservation of rare species. A participation plan could take the form of one or more Memoranda of Agreement.

1.2.1 Develop and implement an outreach plan (Priority 2).

An outreach plan should focus on providing information to interested and affected landowners about (1) species covered in the plan, (2) what is meant by recovery, (3) how recovery can be achieved, and (4) the need of fire management for habitat maintenance. Private landowners should become familiar with rare gabbro plant species that occur on their land, with the significance of the populations, and with available conservation measures, including conservation easements and incentive programs (see Task 1.2.2). For private lands with potential occurrences of species covered in the plan (with historical occurrences or otherwise within the range of the species), permission should be sought to conduct surveys. If populations of species covered in the plan are identified, landowners should be informed of their significance and should be encouraged to continue land uses that support the species' habitat.

1.2.2 Develop and implement economic or other incentives for conservation and recovery on private lands through the cooperative program and other groups (Priority 2).

Support and assistance of private landowners in conserving and recovering species covered in this plan may be gained through economic and other incentive programs.

2. Protect and secure existing populations.

Natural lands that are known to contain species covered in this plan should be protected in perpetuity. Protection of these lands includes identification and minimization of threats in perpetuity and application of appropriate and adaptive management (see Task 3) to ensure species survival and recovery. Natural lands that need protection can be categorized into two types: (1) blocks of land that contain occupied or potential habitat for *two or more* species covered in the plan (Table IV-1) and (2) blocks of land that contain occupied or potential habitat for *one* species covered in the plan (Table IV-2).

2.1 Protect and secure areas important for recovery/conservation of two or more species covered in the plan.

Table IV-1 lists blocks of land that contain occupied or potential habitat for two or more species covered in the plan. Public and conservation lands should be managed to support listed and other sensitive species. Private lands should either be acquired at fair market value or protected through conservation management agreements, easements, or other mechanisms and then managed to support listed and other sensitive species. Boundaries of recovery areas should be refined using the most accurate and up-to-date information on parcel ownership and assessor's maps (see Task 2.3).

Table IV-1. Geographic areas targeted for protection of two or more species covered in the plan. See Figures II-3 and II-5 for locations of geographic areas.

Task #	Location	Listed Taxa and Taxa of Concern (Listed taxa and taxa of concern are separated by dashed line)	Landowner / Comments	Priority
	EL DORADO COUNTY			
2.1.1	Cameron Park	*Calystegia stebbinsii* *Ceanothus roderickii* *Galium californicum* ssp. *sierrae* *Senecio layneae* — *Wyethia reticulata*	-Rare Plant Advisory Committee recommendation -182 hectares (450 acres) - private, Bureau of Land Management -fire management needed - in rapidly developing area -47.3 hectares (117 acres) currently managed by Bureau of Land Management	1
2.1.2	Cameron Park	*Calystegia stebbinsii* *Ceanothus roderickii* *Galium californicum* ssp. *sierrae* *Senecio layneae* — *Wyethia reticulata*	-approximately 73 hectares (180 acres) -contiguous with 182 hectares (see task 2.1.1) -private -fire management needed	2

Task #	Location	Listed Taxa and Taxa of Concern (Listed taxa and taxa of concern are separated by dashed line)	Landowner / Comments	Priority
2.1.3	Pine Hill	*Ceanothus roderickii* *Fremontodendron californicum* ssp. *decumbens* *Senecio layneae* — *Wyethia reticulata*	- California Department of Fish and Game, California Department of Forestry, Bureau of Land Management; includes 145.7 hectares (360 acres) public land and 194.3 hectares (480 acres) private land -private land should be acquired either through fee title or conservation easements -fire management needed - contains the majority of known locations of *Fremontodendron californicum* ssp. *decumbens* - potential enhancement site for *Galium californicum* ssp. *sierrae*	1

Task #	Location	Listed Taxa and Taxa of Concern (Listed taxa and taxa of concern are separated by dashed line)	Landowner / Comments	Priority
2.1.4	Martel Creek	*Senecio layneae* possibly *Galium californicum* ssp. *sierrae* ---- *Wyethia reticulata*	- includes 81 hectares (200 acres) Bureau of Land Management land and 111 hectares (274 acres) private land -fire management needed - presence of *Galium californicum* ssp. *sierrae* needs to be confirmed -potential enhancement or repatriation site for *Galium californicum* ssp. *sierrae* and *Fremontodendron californicum* ssp. *decumbens* -private land should be acquired either through fee title or conservation easements	1
2.1.5	Penny Lane	*Senecio layneae* ---- *Wyethia reticulata*	- Bureau of Land Management -fire management needed	1

Task #	Location	Listed Taxa and Taxa of Concern (Listed taxa and taxa of concern are separated by dashed line)	Landowner / Comments	Priority
2.1.6	Salmon Falls Preserve	*Calystegia stebbinsii* *Ceanothus roderickii* *Galium californicum* ssp. *sierrae* *Senecio layneae* ---- *Wyethia reticulata*	- private, Bureau of Land Management, California Department of Fish and Game - 995.5 hectares (approximately 730 hectares (1,805 acres) private land and 265.5 hectares (656 acres) public land) -fire management needed - potential enhancement site for *Galium californicum* ssp. *sierrae* and introduction site for *Fremontodendron californicum* ssp. *decumbens*	1
2.1.7	Salmon Falls	*Calystegia stebbinsii* *Ceanothus roderickii* *Galium californicum* ssp. *sierrae* *Senecio layneae* ---- *Wyethia reticulata*	-65 hectares (160 acres) -private -contiguous with the 995.5 hectares (2,461 acres) referred to in task 2.1.6	2
2.1.8	Preserve 3	*Calystegia stebbinsii* *Senecio layneae* ---- *Wyethia reticulata*	-44.6 hectares (110.4 acres) -private, El Dorado County -fire management needed	2
2.1.9	Preserve 5	*Ceanothus roderickii* *Senecio layneae* ---- *Wyethia reticulata*	-29.5 hectares (72.9 acres) -private -fire management needed	2

2.2 Protect and secure areas important for recovery/conservation of single species covered in the plan.

Table IV-2 lists areas that contain occupied or potential habitat for single species covered in the plan. Public and conservation lands should be managed to support listed and other sensitive species. Private lands should either be acquired at fair market value or protected through conservation management agreements, easements, or other mechanisms and then managed to support listed and other sensitive species. Boundaries of recovery areas should be refined using the most accurate and up-to-date information on parcel ownership and assessor's maps (see Task 2.3).

Table IV-2. Geographic areas targeted for protection of single species covered in the plan. See Figures II-3 and II-5 for locations of geographic areas.

Task #	**Location**	**Listed Taxon or Species of Concern** (Listed taxa and taxa of concern are separated by a dashed line)	**Landowner / Comments**	**Priority**
	EL DORADO COUNTY			
2.2.1	Preserve 6	*Senecio layneae*	-private -potential site for introduction of *Calystegia stebbinsii* and *Ceanothus roderickii* -approximately 61 hectares (150 acres)	2
2.2.2	Specialty preserves for *Galium californicum* ssp. *sierrae*	*Galium californicum* ssp. *sierrae*	-should target dense oak woodland on Rescue series soils	1

Task #	Location	Listed Taxon or Species of Concern (Listed taxa and taxa of concern are separated by a dashed line)	Landowner / Comments	Priority
2.2.3	Eldorado National Forest	*Senecio layneae*	-three occurrences of *Senecio layneae* -Eldorado National Forest -other species that might benefit, but are not the target of this recovery plan are: *Eriogonum tripodium* (tripod buckwheat), *Allium sanbornii* var. *congdonii* (Congdon's onion), and *Allium sanbornii* var. *sanbornii* (Sanborn's onion)	2
	NEVADA COUNTY			
2.2.4	Grass Valley	*Calystegia stebbinsii*	- private and Bureau of Land Management - northern most occurrence for *Calystegia stebbinsii* -possibly *Fremontodendron californicum* ssp. *decumbens*	1
	YUBA COUNTY			
2.2.5	Bureau of Land Management (Yuba County land)	*Senecio layneae*	- Bureau of Land Management and private -possibly *Fremontodendron californicum* ssp. *decumbens*	2
	TUOLUMNE COUNTY			

80

Task #	Location	Listed Taxon or Species of Concern (Listed taxa and taxa of concern are separated by a dashed line)	Landowner / Comments	Priority
2.2.6	Red Hills	*Senecio layneae*	- Bureau of Land Management -represents southern range of *Senecio layneae*	2

2.3 Refine preserve boundaries (Priority 1).

Development in western El Dorado County is occurring rapidly. Some of the areas targeted for protection in Table IV-1 and Table IV-2 may already be developed. Boundaries of recovery areas should be refined using the most accurate and up-to-date information on parcel ownership and assessor's maps.

3. Manage habitat.

Managing habitat is essential to the recovery of listed species and the long-term conservation of the species of concern included in this plan. Habitat management includes preparation and implementation of management plans for all areas inhabited by special status species being proposed for preservation, and periodic monitoring of populations in each of these areas. Within western El Dorado County, a multi-constituent committee should be formed to oversee the management of preserves located on the Pine Hill formation. The preserve management committee should include, at a minimum, representatives from the California Department of Fish and Game, U.S. Fish and Wildlife Service, Bureau of Land Management, El Dorado County, California Native Plant Society, American River Conservancy, and a private landowner representative.

3.1 Establish a funding mechanism to cover the cost of the ongoing long-term maintenance and management of the preserves on the Pine Hill formation (Priority 1).

An endowment fund for the long-term maintenance or management should be established. Potential sources of funding the endowment fund include an ecological preserve fee, water rate surcharges, increased water connection charges, or a combination of State and Federal grants.

3.2 Hire a preserve manager for Pine Hill formation preserves in El Dorado County (Priority 1).

The preserve manager should have a background in botany or plant ecology, and be knowledgeable about the management of natural areas. The duties of the preserve manager would include: (1) coordinating implementation of management tasks from the preserve oversight committee; (2) conducting or coordinating monitoring of rare plant populations; (3) coordinating with staff involved in managing the California Department of Fish and Game Pine Hill Ecological Reserve, Bureau of Land Management lands, and Eldorado National Forest; (4) coordinating with public or private groups that are interested in visiting the preserves; and (5) enlisting and supervising volunteers who can help with preserve monitoring and maintenance activities.

3.3 Prepare management plans and implement appropriate management in areas inhabited by special status species (Priority 1).

Management plans should be developed and implemented for areas identified in Tables IV-1 and IV-2 that are inhabited by special status species. Management plans should also include strategies to minimize threats to special status species, as well as to identify new threats should they appear. If new threats are identified or other new information becomes available, management plans need to be re-evaluated and revised. Additionally, management plans should include an operations and maintenance schedule for the completion of ongoing routine tasks and one-time tasks. Management activities should be evaluated periodically, and adjusted as indicated to maximize the potential for survival, conservation, and recovery of listed species and other species of concern. This process of evaluating and adjusting management as needed is termed "adaptive management". Results of new biological research (see Task 5) should also be considered in adaptive management schemes.

3.4 Establish a monitoring protocol for the species covered in this plan (Priority 1).

Monitoring protocols should be developed to evaluate the success of management activities and to determine trends of the rare plant populations. Standardized protocols are needed to ensure consistency of monitoring performed between people and over time.

3.5 Develop and implement monitoring plans for special status species populations in all areas being proposed for preservation (Priority 2).

Monitoring plans should be developed for all areas inhabited by populations of listed species and the species of concern that are proposed for preservation. These populations should then be monitored at time intervals appropriate for each species. Monitoring efforts for co-occurring species (e.g., at Pine Hill) should be coordinated to increase efficiency and reduce costs. Population monitoring should continue where currently underway and should begin, wherever possible, for all other populations regardless of whether management plans have been developed or formal protection has been secured. Monitoring is also necessary to determine the condition of the preserves, and to determine the need to conduct maintenance activities.

4. Survey historical locations and other potential habitat where species covered in the plan may occur.

Recovery of listed species and long-term conservation of the species of concern covered in this plan will often require relocating historic populations or locating new populations of these species. Historical locations should be surveyed to determine whether suitable habitat remains, the species persists at the sites, and/or the sites may be suitable for repatriation. Suitability of historical locations for repatriation would depend upon (1) whether potential habitat exists, (2) the presence and magnitude of threats, and (3) whether the sites can be secured and managed for the long-term protection of the species. Surveys should also include other potential gabbro or serpentine habitat to determine whether undiscovered populations may exist. If new populations are discovered, they should be protected and managed as discussed above. During the surveys, potential introduction sites should also be identified.

Specific locations that need to be surveyed for one or more species covered in the plan are given in Table IV-3. To increase efficiency and reduce costs, integrated programs involving several species in the same geographic area should be implemented where possible.

4.1 Establish a survey program and protocol for species covered in the plan (Priority 2).

Botanical surveys need to follow a standard protocol.

4.2 Conduct general and directed surveys.

General surveys of potential gabbro and serpentine habitat in each geographic area are needed as well as directed surveys of historical locations and other areas that are especially likely to contain species covered in the plan. General surveys of all areas being proposed for preservation are needed to determine potential areas for introduction or expansion of populations. Needs for directed surveys (i.e. for specific species in specific areas) are given in Table IV-3.

Table IV-3. Directed survey needs of historical and potential habitat by geographic area. See Figures II-3 and II-5 for locations of specific geographic areas.

Task #	Location	Listed Taxa and Taxa of Concern	Comments	Priority
	EL DORADO COUNTY			
4.2.1	Northwest of Salmon Falls	*Galium californicum* ssp. *sierrae*		1
4.2.2	Martel Creek	*Galium californicum* ssp. *sierrae*		2
4.2.3	Serpentine soil areas	*Senecio layneae*	for areas off the Pine Hill formation	2
	NEVADA COUNTY			
4.2.4	Serpentine soil areas	*Calystegia stebbinsii*	possibly *Fremontodendron californicum* ssp. *decumbens*	2
	YUBA COUNTY			
4.2.5	Private and public land Mildred soil series	*Senecio layneae*	possibly *Fremontodendron californicum* ssp. *decumbens*	2
	TUOLUMNE COUNTY			

85

Task #	Location	Listed Taxa and Taxa of Concern	Comments	Priority
4.2.6	Serpentine near Red Hills	*Senecio layneae*		2

5. Conduct necessary biological research and use results to guide recovery/conservation efforts.

Table IV-4 compiles research needs by geographic area for species covered in the plan. Research on habitat management and population biology is important as the basis for adaptive management (see Task 3 above) and to guide repatriation or introduction efforts (see Task 6 below). A summary of research needs for each species is given in Appendix D.

Table IV-4. Research needs by geographic area. Additional information given in individual species accounts (Chapter II). See Figures II-3 and II-5 for locations of geographic areas.

Task #	Location	Tasks and Target Species	Comments	Priority
5.1.1	(not applicable)	- develop propagation techniques for all listed plant species and plant species of concern		2
EL DORADO COUNTY				
5.1.2	County-wide: selected habitat	- effects of fire for *Galium californicum* ssp. *sierrae*, *Senecio layneae*, *Chlorogalum grandiflorum*, and *Helianthemum suffrutescens* need to be determined. -develop fire management techniques for all species	-test a variety of methods experimentally across sites and years. Results should be quantifiable.	1

Task #	Location	Tasks and Target Species	Comments	Priority
5.1.3	County-wide: selected areas	- determine the feasibility of restoring habitat by burning areas of dense chaparral that occur on selected Rescue series soil types (*Calystegia stebbinsii*)	- success of restoration for other plan species should also be evaluated	1
5.1.4	Cameron Park Preserve	-demographic studies determining limiting life stages for *Calystegia stebbinsii*, *Ceanothus roderickii*, *Galium californicum* ssp. *sierrae*, *Senecio layneae*, and *Wyethia reticulata* - influence of disturbance and fire on seedling establishment (*Senecio layneae*)		1
5.1.5	Cameron Park Preserve	-genetics of *Senecio layneae* -genetics of *Calystegia stebbinsii*	-population genetics studies to clarify the relationship of El Dorado County populations of *Calystegia stebbinsii* to the Nevada County population	2
5.1.6	Pine Hill Preserve	- demography, reproduction, ecology, and genetics of *Galium californicum* ssp. *sierrae* -demographic studies determining limiting life stages for *Ceanothus roderickii*, *Senecio layneae*, and *Wyethia reticulata* - influence of disturbance and fire on seedling establishment (*Senecio layneae*)	- potential enhancement or repatriation site for *Galium californicum* ssp. *sierrae* -ecological and genetic studies for *Galium californicum* ssp. *sierrae*	1
5.1.7	Pine Hill Preserve	-genetic study of *Senecio layneae*	-genetic study of *Senecio layneae* to determine the level of genetic diversity between and among populations	2

Task #	**Location**	**Tasks and Target Species**	**Comments**	**Priority**
5.1.8	Salmon Falls Preserve	Demographic studies determining limiting life stages for *Calystegia stebbinsii*, *Ceanothus roderickii*, *Galium californicum* ssp. *sierrae*, *Senecio layneae*, and *Wyethia reticulata* -demography, reproduction, ecology, and genetics studies for *Galium californicum* ssp. *sierrae* - influence of disturbance and fire on seedling establishment (*Senecio layneae*)	-controlled burns should be performed on dense chaparral on Bureau of Land Management Lands to manage for *Calystegia stebbinsii*	1
5.1.9	Salmon Falls Preserve	-genetics of *Calystegia stebbinsii* -genetic study of *Senecio layneae*	-detailed genetic analysis of *Calystegia stebbinsii* -population genetics studies to clarify the relationship of El Dorado County populations of *Calystegia stebbinsii* to the Nevada County population -genetic study of *Senecio layneae* to determine the level of genetic diversity between and among populations	2
	NEVADA COUNTY			
5.1.10	Grass Valley	-decumbent *Fremontodendron* should be identified. If it is *Fremontodendron californicum* ssp. *decumbens*, then demographic studies of the limiting factors of its life cycle at this location should be studied		1

Task #	Location	Tasks and Target Species	Comments	Priority
5.1.11	Grass Valley	genetic study of *Calystegia stebbinsii*	-population genetics studies to clarify the relationship of El Dorado County populations of *Calystegia stebbinsii* to Nevada County population	2
	TUOLUMNE COUNTY			
5.1.12	Red Hills Management Area	-effects of different grazing regimes on *Senecio layneae*		2
5.1.13	Red Hills Management Area	-genetic study of *Senecio layneae*	-genetic study of *Senecio layneae* to determine the level of genetic diversity between and among populations.	2
	YUBA COUNTY			
5.1.14	Southwest of Brownsville	-identification of decumbent *Fremontodendron*		1
5.1.15	Southwest of Brownsville	-genetic study of *Senecio layneae*	-genetic study of *Senecio layneae* to determine the level of genetic diversity between and among populations	2

6. Undertake artificial enhancement, repatriation, or introduction efforts, where necessary.

Where it is deemed necessary, artificial enhancement, repatriation, or introduction efforts for sensitive plants should be undertaken. Prior to repatriation or introduction of sensitive plants, genetics studies are needed (see Task 5) to ensure that new populations will not disrupt unique local gene complexes. Plant repatriation or introduction efforts should be undertaken using collected seeds or plant propagules.

6.1 Collect and store seed for plant taxa covered in the plan.

Because they occur in very few locations, collection and banking of seed of the following four plant taxa in Center for Plant Conservation certified botanic gardens is prudent to guard against extinction from chance catastrophic events. Seed collections for plant taxa should be representative of both population and species level genetic diversity. Seed collection guidelines have been published by the Center for Plant Conservation (1991). Plant taxa for which seed banking is necessary are given in Table IV-5. Priority 1 is given to taxa known from one or two locations. Priority 2 is given to the disjunct populations of plants that occur off the Pine Hill formation.

Table IV-5. Plant taxa for which seeds need to be stored.

Task #	Taxa	Priority
6.1.1	*Fremontodendron californicum* ssp. *decumbens* *Galium californicum* ssp. *sierrae*	1
6.1.2	disjunct populations of *Calystegia stebbinsii*	2
6.1.3	disjunct populations of *Senecio layneae*	2

6.2 Initiate enhancement, repatriation, or introductions where appropriate (Priority 2).

Artificially propagated plants, or collected seeds, can provide potential material for enhancement efforts in existing populations, repatriation of former sites, and/or introductions to new sites. Surveys of appropriate gabbro and serpentine habitat (see Task 4) should identify suitable sites for repatriations or introductions. Enhancement of populations of species should occur within acquired preserves.

7. Periodically review the status of the species of concern (Priority 3).

Listing of *Wyethia reticulata* may be necessary if tasks specific to the needs of this species are not undertaken within 5 years of recovery plan approval.

V. IMPLEMENTATION SCHEDULE

The implementation schedule that follows outlines actions and estimated costs for this recovery plan. It is a guide for meeting the objectives discussed in Chapter III. This schedule describes and prioritizes tasks, provides an estimated time table for performance of tasks, indicates the responsible agencies, and estimates costs of performing tasks. These actions, when accomplished, should further the recovery and conservation of the covered species.

Key to Acronyms used in the Implementation Schedule:

Definition of task priorities:

Priority 1 - An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in the species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet recovery or conservation objectives.

Definition of task durations:

Continual - A task that will be implemented on a routine basis once begun.

Ongoing - A task that is currently being implemented and will continue until action is no longer necessary.

Unknown - Either task duration or associated costs are not known at this time.

Total costs:

TBD - To be determined

Responsible parties:

ARC - American River Conservancy
BLM - Bureau of Land Management
BOR - Bureau of Reclamation
CDFG - California Department of Fish and Game
CDF - California Department of Forestry and Fire Protection
Caltrans - California Department of Transportation
CNPS - California Native Plant Society
COUN - County
EID - El Dorado Irrigation District
ENF - Eldorado National Forest
FERC - Federal Energy Regulatory Commission
OWN - Private landowners or parties
RSABG - Rancho Santa Ana Botanic Garden
UCB - University of California Berkeley
USFWS - U.S. Fish and Wildlife Service

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Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
1	2.1.1	Protect and secure 182 hectares (450 acres) of the Cameron Park Preserve for multiple species	5 years	USFWS BLM CDFG COUN EID BOR	80	16	16	16	16	47.3 hectares (117 acres) acquired in 1997. Total cost does not include price of the 47.3 hectares.
1	2.1.3	Protect and secure Pine Hill Preserve for multiple species	10 years	BLM CDFG USFWS COUN CDF OWN	31	3.1	3.1	3.1	3.1	
1	2.1.4	Protect and secure Martel Creek Preserve for multiple species	10 years	USFWS BLM CDFG COUN OWN	178	17.8	17.8	17.8	17.8	
1	2.1.5	Protect and secure Penny Lane Preserve for multiple species	3 years	BLM	0.75	0.25	0.25	0.25		

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
1	2.1.6	Protect and secure Salmon Falls Preserve for multiple species	10 years	USFWS BLM CDFG COUN EID BOR	107	10.7	10.7	10.7	10.7	Includes value of density transfer
1	2.2.2	Protect and secure specialty preserve for *Galium californicum* ssp. *sierrae*	10 years	USFWS BOR FERC CDFG BLM	15	1.5	1.5	1.5	1.5	
1	2.2.4	Protect and secure Grass Valley Preserve for single species	10 years	USFWS COUN	TBD					
1	2.3	Refine preserve boundaries	6 months	USFWS COUN	TBD					
1	3.1	Establish a funding mechanism for long-term maintenance and management of the Pine Hill formation preserves in perpetuity	ongoing	COUN USFWS	TBD					USFWS to cover 30 percent of funding mechanism

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
1	3.2	Hire preserve manager for the Pine Hill formation	ongoing	COUN	TBD	1	1	1	1	
1	3.3	Prepare management plans and implement appropriate management in areas inhabited by special status species	ongoing	BLM CDFG COUN ENF CNPS ARC COUN	TBD					
1	3.4	Develop monitoring techniques and protocol for all species	4 years	USFWS CDFG BLM ENF COUN	8	2	2	2	2	
1	4.2.1	Conduct surveys for *Galium californicum* ssp. *sierrae* northwest of Salmon Falls	2 years	USFWS BLM CDFG COUN	0.2	0.1	0.1			

Implementation Schedule for the Gabbro Plant Draft Recovery Plan										
					Cost Estimates (in $100,000 units)					
Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Total Costs	FY 1	FY 2	FY 3	FY 4	Comments/Notes
1	5.1.2	Conduct county wide research on fire	continual	USFWS CDFG CDF BLM ENF COUN	60	2	2	2	2	
1	5.1.3	Determine feasibility of habitat restoration	ongoing	USFWS CDFG CDF BLM COUN	TBD					
1	5.1.4	Conduct necessary demographic studies at the Cameron Park Preserve	8 years	USFWS CDFG	4	0.5	0.5	0.5	0.5	
1	5.1.6	Conduct necessary demographic and fire research at the Pine Hill Preserve	8 years	USFWS CDFG CDF	4	0.5	0.5	0.5	0.5	
1	5.1.8	Conduct necessary studies at the Salmon Falls Preserve	8 years	USFWS CDFG	4	0.5	0.5	0.5	0.5	

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

					Cost Estimate (in $100,000 units)					
Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Total Costs	FY 1	FY 2	FY 3	FY 4	Comments/Notes
1	5.1.10	Identify decumbent *Fremontodendron* located at Grass Valley (Nevada County)	2 years	USFWS CDFG	0.02	0.01	0.01			If *Fremontodendron californicum* ssp. *decumbens*, demographic studies should be performed
1	5.1.14	Identify decumbent *Fremontodendron* located in Yuba County	2 years	USFWS BLM CDFG	0.02	0.01	0.01			If *Fremontodendron californicum* ssp. *decumbens*, demographic studies should be performed
1	6.1.1	Collect and store viable seed for *Fremontodendron californicum* ssp. *decumbens* and *Galium californicum* ssp. *sierrae*	5 years	USFWS CDFG BLM UCB RSABG	0.75	0.15	0.15	0.15	0.15	
2	1.1	Establish cooperative programs with participants from the public and private sector	ongoing	USFWS CDFG	TBD					
2	1.2.1	Develop and implement outreach plans	ongoing	USFWS	TBD					

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

					Cost Estimate (in $100,000 units)					
Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Total Costs	FY 1	FY 2	FY 3	FY 4	Comments/Notes
2	1.2.2	Develop and implement economic and other incentives	ongoing	USFWS CDFG COUN OWN	TBD					
2	2.1.2	Protect and secure 73 hectares (180 acres) of the Cameron Park Preserve for multiple species	5 years	USFWS BLM CDFG BOR	45	9	9	9	9	
2	2.1.7	Protect and secure 65 hectares (160 acres) of the Salmon Falls Preserve for multiple species	10 years	USFWS BLM CDFG BOR	10	1	1	1	1	
2	2.1.8	Protect and secure Preserve 3 for multiple species	10 years	USFWS BOR FERC CDFG BLM Caltrans	38.5	3.85	3.85	3.85	3.85	

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
2	2.1.9	Protect and secure Preserve 5 for multiple species	10 years	USFWS BOR FERC CDFG BLM	19	1.9	1.9	1.9	1.9	
2	2.2.1	Protect and secure Preserve 6 for single species	10 years	USFWS BOR FERC CDFG BLM	37.5	3.75	3.75	3.75	3.75	
2	2.2.3	Protect and secure occurrences of *Senecio layneae* on the Eldorado National Forest	3 years	ENF COUN	0.75	0.25	0.25	0.25		
2	2.2.5	Protect and secure Bureau of Land Management Yuba County land, southwest of Brownsville for single species	3 years	BLM	0.75	0.25	0.25	0.25		
2	2.2.6	Protect and secure Red Hills for single species	3 years	BLM	0.75	0.25	0.25	0.25		

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
2	3.5	Develop and implement monitoring plans for special status species populations in all areas being proposed for preservation	continual	USFWS CDFG BLM	TBD					
2	4.1	Establish a survey program and protocols for all species covered in the plan	4 years	USFWS CDFG BLM ENF	4	1	1	1	1	
2	4.2.2	Survey potential habitat at Martel Creek for *Galium californicum* ssp. *sierrae*	2 years	USFWS CDFG BLM	0.2	0.1	0.1			
2	4.2.3	Survey historic and potential habitat on serpentine soils for *Senecio layneae* (El Dorado County)	4 years	USFWS CDFG BLM	0.6	0.15	0.15	0.15	0.15	
2	4.2.4	Survey potential habitat on the serpentine soils in Nevada County	4 years	USFWS CDFG BLM	0.8	0.2	0.2	0.2	0.2	
2	4.2.5	Survey potential habitat for *Senecio layneae* in Yuba County	4 years	USFWS CDFG BLM	0.8	0.2	0.2	0.2	0.2	

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $000,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
2	4.2.6	Survey potential habitat in Tuolumne County for *Senecio layneae*	4 years	USFWS CDFG BLM	0.6	0.15	0.15	0.15	0.15	
2	5.1.1	Throughout the species' range: Develop plant propagation techniques for all listed species and species of concern	10 years	USFWS CDFG COUN RSABG	6	0.6	0.6	0.6	0.6	
2	5.1.5	Conduct genetic studies of *Calystegia stebbinsii* and *Senecio layneae*	2 years	USFWS CDFG	0.024	0.012	0.012			
2	5.1.7	Conduct genetic study of *Senecio layneae* on the Pine Hill Preserve	2 years	USFWS CDFG BLM	0.012	0.006	0.006			
2	5.1.9	Conduct genetic studies of *Calystegia stebbinsii* and *Senecio layneae* on the Salmon Falls Preserve	2 years	USFWS CDFG BLM	0.024	0.012	0.012			
2	5.1.11	Conduct genetic study of *Calystegia stebbinsii* at Grass Valley	2 years	USFWS CDFG	0.012	0.006	0.006			

102

Implementation Schedule for the Gabbro Plant Draft Recovery Plan

Task Priority	Task Number	Task Description	Task Duration	Responsible Parties	Cost Estimate (in $100,000 units)					Comments/Notes
					Total Costs	FY 1	FY 2	FY 3	FY 4	
2	5.1.12	Conduct grazing study on *Senecio layneae* on the Red Hills Management area	5 years	BLM	0.5	0.1	0.1	0.1	0.1	
2	5.1.13	Conduct genetic study of *Senecio layneae* on the Red Hills (Tuolumne County)	2 years	USFWS CDFG BLM	0.012	0.006	0.006			
2	5.1.15	Conduct genetic study on *Senecio layneae* southwest of Brownsville (Yuba County)	2 years	USFWS BLM CDFG	0.012	0.006	0.006			
2	6.1.2	Collect and store seeds for disjunct populations of *Calystegia stebbinsii*	5 years	USFWS CDFG UCB RSABG	0.3	0.06	0.06	0.06	0.06	
2	6.1.3	Collect and store viable seeds for disjunct populations of *Senecio layneae*	5 years	USFWS BLM CDFG UCB RSABG	0.3	0.06	0.06	0.06	0.06	
3	7	Periodically review the status of the species of concern	ongoing	USFWS	TBD				0.20	

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VII. APPENDICES

A. Priorities for Recovery of Threatened and Endangered Species.

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict[1]
High	High	Monotypic Genus	1	1C 1
	High	Species	2	2C 2
	High	Subspecies	3	3C 3
	Low	Monotypic Genus	4	4C 4
	Low	Species	5	5C 5
	Low	Subspecies	6	6C 6
Moderate	High	Monotypic Genus	7	7C 7
	High	Species	8	8C 8
	High	Subspecies	9	9C 9
	Low	Monotypic Genus	10	10C 10
	Low	Species	11	11C 11
	Low	Subspecies	12	12C 12
Low	High	Monotypic Genus	13	13C 13
	High	Species	14	14C 14
	High	Subspecies	15	15C 15
	Low	Monotypic Genus	16	16C 16
	Low	Species	17	17C 17
	Low	Subspecies	18	18C 18

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[1] C - conflict with human activities

B. Analysis of potential preserve sites
(El Dorado County Planning Staff 1992)

1. **Site 1 (Shingle Springs Area Plan)**
   - Total Acreage: 62.6
   - Zoning
     - Site: RE-5
     - Surrounding: R1A/RE-5 - North
       RE-5 South, East, West
   - Land Use
     - Site: Low Density Residential (1 du/5-9.9A)
     - Surrounding: Medium Density/Low Density - North
       Low Density - South, East, West
   - Public Lands: None
   - Number of Parcels: 10
     3 - structure(s)
     7 - land
     Acreage Range: 2.0 to 10.5 acres
   - Projects: None
   - Score in Rare Plants Study: 11
   - Rare Plants Present: Stebbins' morning-glory
     Layne's butterweed
     El Dorado mule-ears

2. **Site 2 (Shingle Springs/Barnett Ranch Area Plans)**
   - Total Acreage: 73.88
   - Zoning
     - Shingle Springs
       - Site: R1A
     - Barnett Ranch
       - Site: CPO-DC/CG-DC
     - Surrounding Zoning: CPO-DC/CG-DC - North
       I-DC - South
       R1A/RE-5 - East

I-DC - West

Land Use

Shingle Springs

Site: Medium Density (1du/1-4.9A)

Barnett Ranch

Site: Commercial Professional Office/Industrial-DC

Surrounding Use: Commercial Professional. Office - North
Industrial-DC - South
MD/Low Density (1du/5.0-9.0 A) - East
CPO/Industrial-DC - West

Public Lands: None

Number of Parcels: 30
5 structure(s) (I commercial, I apartment complex)
25 land (at least 13 parcels within Barnett Business Park)
Acreage Range: 0.57 to 24.4 acres

Projects: None

Score in Rare Plant Study: 6-7

Rare Plants Present: Stebbins' morning-glory
Layne's butterweed
Red Hills soaproot

3. Site 3 (Shingle Springs/Cameron Park/Barnett Ranch Area Plans)

Total Acreage: 110.37

Zoning

Shingle Springs

Site: RE-5/R2-PD

Cameron Park

Site: Industrial/Planned Commercial

Barnett Ranch

Site: RE-5

Surrounding Zoning: Highway 50 - North
I/RE-5/I-DC - South

RE-5 - East
CP - West

Land Use

Shingle Springs
Site: Multi-family residential
Cameron Park
Site: Industrial/Commercial
Barnett Ranch
Site: Commercial Professional Office/Industrial
Surrounding Use: Highway 50 - North
Industrial/SFRLD - South
Multifamily Res. (5.1-20 du/A) - East
Commercial - West

Public Lands: None

Number of Parcels: 13 (all land)
2 County Owned
Acreage Range: 0.57 to 50.1 acres

Projects: None

Score in Plant Study: 21

Rare Plants Present: Stebbins' morning-glory
Pine Hill ceanothus
Layne's butterweed
El Dorado mule-ears
Red Hills soaproot

4. Site 4 (Shingle Springs/Cameron Park Area Plans)

Total Acreage: 637.68 (plus 6 subdivision lots of indeterminate acreage)

Zoning

Shingle Springs
Site: RE-5
Cameron Park
Site: RE-10-PD/RE-10/R1/R2-PD/C
Surrounding Zoning.: RE-10/R1/R1A/RE-5 - North
Highway 50/RT/C/RM - South

RE-5 - East
R1 - West

Land Use

Shingle Springs
Site: Low Density (1 du/5-9.9 A)
Cameron Park
Site: HD-PD (4.2 du/A)/HD (1.1-3 du/A) /MFR/Comm.
Surrounding Use: SFRHD (1.1-3 du/A)/SFRLD - North
Multifamily Res. (3.2-20 du/A)/
Highway 50/SFRHD/C - South
SFRLD/SFRMD - East
SFRHD - West

Public Lands: None

Number of Parcels: 37
8 - structure (s)
29 - land (6 parcels within Cameron Park Unit 6)
Acreage Range: subdivision lots to 151.9 acres

Projects: TM 89-1156 (Ponderosa 50; on hold)
TM 90-1214 (The Pinnacles; on hold)
P90-18 (approved parcel map)

Score in Plant Study: 56-58

Rare Plants Present: Stebbins' morning-glory
Pine Hill ceanothus
El Dorado bedstraw
Layne's butterweed
Red Hills soaproot
El Dorado mule-ears

5. **Site 5 (Cameron Park Area Plan)**

Total Acreage: 72.9

Zoning
Site: RE-10/RI
Surrounding: R2/R1 - North

115

CPO/R1 - South
RE-10/RI - East
CP/CG - West

Land Use:

Site: SFRHD

Surrounding: SFRHD - North, East
SFRHD/Commercial - S
Commercial - West

Public Lands: None

Number of Parcels: 2 (land only)
Acreage Range: 2.5 to 70.4 acres

Projects: TM 89-1153 (Sunset Heights) - pending
TM87-1073 (Cameron Ridge) - approved (2.5 acre parcel is only a small portion of the approved subdivision)

Score in Rare Plant Study: 33

Rare Plants Present: Stebbins' morning-glory
Pine Hill ceanothus
Layne's butterweed
El Dorado mule-ears
Red Hills soaproot

6. Site 6 (El Dorado Hills/Cameron Park Area Plans)

Total Acreage: 523.8 (plus 9 subdivision lots of indeterminate size)

Zoning

El Dorado Hills

Site: R1

Cameron Park

Site: R1/RE-5

Surrounding Zoning: R1/RE-5 - North, East
RI - South, West

Land Use

El Dorado Hills

Site: SFRHD (5 du max/A)

Cameron Park

Site: SFRHD

Surrounding Use: SFRHD - North, South, East, West

Public Lands: None

Number of Parcels: 26

4 - structure(s)

22 - land

Acreage range: subdivision lots to 261.5 acres

Projects: TM89-1164 (Bass Lake Estates) - on hold

TM88-1104 (Woodleigh Ridge) - approved

Score in Rare Plant Study: 9

Rare Plants Present: Stebbins' morning-glory

Pine Hill ceanothus

Red Hills soaproot

Bisbee Peak rush rose

Layne's butterweed

El Dorado mule-ears

7. Site 7 (Rescue Area Plan)

Total Acreage: +/- 180

Zoning

Site: RE (Estate Residential, 5 A minimum)

Surrounding: RE - North, South, West

RE-10 - East

Land Use

Site: Residential Agriculture, 5 A minimum

Surrounding: Res. Agriculture., 5 A minimum - North, South, West

Res. Agriculture., 10 A minimum - East

Public Lands: DFG Pine Hill Preserve located adjacent to north

Number of Parcels: Entire site is comprised of approved subdivision TM88-1122 (Fremont's Peak)

Score in Rare Plant Study: 34

Rare Plants Present: Pine Hill ceanothus

117

Layne's butterweed
El Dorado mule-ears
Red Hills soaproot

8. Site 8 (Rescue Area Plan)

Total Acreage: 20

Zoning

Site: RE-1/A
Surrounding: A - North
RE-10 - South, East, West

Land Use

Site: Residential Agriculture, 10 A minimum
Surrounding: Parks - North
Res. Agriculture, 10 A - South, East, West

Public Lands: BLM land encompasses far northern portion of site some large BLM holdings to the north and east

Number of Parcels: 2 (both with structure(s))
Acreage Range: Both 10 acres

Projects: None

Score in Plant Study: 14-16

Rare Plants Present: Layne's butterweed
El Dorado mule-ears

9. Site 9 (Rescue/El Dorado Hills Area Plans)

Total Acreage: 311.2 (plus 3 BLM parcels of indeterminate size)

Zoning

Rescue
Site: RE-10
El Dorado Hills
Site: RE-10/OS
Surrounding Zoning: RA-20 - North
RE-10 - South
RE-5/RA-20 - East
RE-10/RE, 5 A min . - West

Land Use

Rescue

Site: Res. Agriculture., 10 A minimum

El Dorado Hills

Site: LDR (1 du/5.9.9A)

Surrounding Use: SFRLD - North, West
Res. Agriculture., 10 A - South, East

Public Lands: Large portion of site comprised of BLM land

Number of parcels: 16 (all land)
3 BLM parcels
Acreage range: 4.0 to 40 acres

Score in Plant Study: 16-26

Rare Plants Present: El Dorado Bedstraw
Layne's butterweed
El Dorado mule-ears
Red Hills soaproot

10. Site 10 (El Dorado Hills Area Plan)

Total Acreage: 524.49

Zoning

Site: RA-20/RE-1/RF/RE-5

Surrounding: RA-20/R3A/RE-5/RF/R1A - North
RE-10 - South
RA-20 - East
RE-10/RE-5 - West

Land Use

Site: RRA/MDR (1 du/1.0-4.9A)/Parks & Recreation

Surrounding: RRA/MDR/P&R - North
RRA - South
LDR - East
RRA/LDR - West

Misc.: Adjacent to Site 11 on east

Public Lands: None

Number of Parcels: 13

3 - structure (s)

10 - land

Acreage range: 0.79 to 264.8

Projects: Proposed Sweetwater project on site (project has no been filed with County)

Score in Plant Study: 79-81

Rare Plants Present: El Dorado mule-ears

Bisbee Peak rush rose

historic occurrences of:

- Pine Hill ceanothus
- Layne's butterweed
- Red Hills soaproot

11. Site 11 (El Dorado Hills/Cool-Pilot Hill Area Plans)

Total Acreage: 1498.33

Zoning

El Dorado Hills

Site: RA-20/RE-1/RE-5

Cool/Pilot Hill

Site: RF/RA-40

Surrounding Zoning: RF/RE-10/RE-5 - North
RA-20/RE-10 - South
RF/RE-10 - East
RE-5/R3A/RA-20 - West

Land Use

El Dorado Hills

Site: RRA/LDR/P&R

Cool/Pilot Hill

Site: RRA/P&R

Surrounding: P&R/SFRLD - North
RRA/SFRLD - South
Res. Agriculture., 10 A - East
SFRLD/SFRMD/RRA - West

Public Lands: 40 acre DFG piece within preserve site; BLM land adjacent to site on north

Number of Parcels: 35

8 - structure (s)

27 - land

Acreage range: 4.1 to 474 acres

Projects: TM91-1246P (Kanaka Valley)

Score in Plant Study: 79-81

Rare Plants Present: Stebbins' morning-glory

Pine Hill ceanothus

El Dorado bedstraw

Layne's butterweed

Red Hills soaproot

Bisbee Peak rush rose

El Dorado mule-ears

12. Site 12 (Rescue Area Plan)

Total Acreage: 738.7

Zoning

Site: RE-10/RE

Surrounding: RE-10/RE - North, South, East, West

Land Use

Site: Residential Agriculture, 10 A/ Res Agriculture., 5 A

Surrounding: Res. Agriculture., 5 A/Res Agriculture., 10 A - North, South, East, West

Public Lands: BLM piece within preserve site

Number of Parcels: 56

33 - structure (s)

23 - land

Acreage range: 5.0 to 120 acres

Projects: P89-18 (approved)

P89-161 (approved)

Score in Plant Study: 39-41

Rare Plants Present: Pine Hill flannelbush

El Dorado bedstraw
El Dorado mule-ears
Layne's butterweed.
Red Hill soaproot

C. Land Characteristics of Four of the Five Rare Plant Preserves

(Economic & Planning Systems, Inc. 1997)

LAND CHARACTERISTICS

El Dorado County has experienced rapid population growth since the 1970s and is projected to grow at an average annual rate of approximately 2.8 percent through the next twenty years *(El Dorado County General Plan Public Review Draft*, December 1993). The recent increase in population in El Dorado County has been primarily caused by relocations from other parts of California, including the extended Bay Area, Sacramento County, and southern California, though this form of relocation is less significant today. Most new home buyers are buying primary residences. In January 1994, the population in El Dorado County was 144,002 (Department of Finance Annual Population and Housing Reports). The part of western El Dorado County which contains the rare gabbroic and serpentine soils is mainly a rural area, although it includes the community of Cameron Park. Historically, many rural homesteads have been created in a patchwork fashion by lot splits. With rapid employment growth in the Sacramento Region in the 1980s (a 3.5 percent annual growth rate between 1980 and 1990) western El Dorado County, which is within a reasonable commute distance of the State capital and other major employment bases in eastern Sacramento County, became a popular location for households seeking a more rural ambiance and access to outdoor recreation. There follows a discussion of the ownership, land uses and characteristics of each of the Ecological Preserves.

Cameron Park Preserve

Cameron Park is located approximately 18 miles east of Sacramento County on Highway 50. This preserve may consist of one or more sites that preserve a total of approximately 400 acres south of Green Valley Road. It is considered necessary to maintain some representation of the rare plant species and their associated habitats in the southern half of the gabbro soil formation.

The single site that was proposed by the advisory committee (see page 1-4) primarily consists of five adjacent parcels ranging in size from 17.3 to 152.0 acres. It stretches from 0.5 to 1.5 miles north of Interstate 50 at the Cameron Park Drive exit, and it's western border varies from approximately 0.1 to 0.25 miles east of Cameron Park Drive. All five parcels are represented by a single landowner. The land is presently zoned RE10 or residential estate with 10 acre minimum lot size. Under the recently adopted General Plan, the majority of the acreage is designated for high density, single family residential development (1-5 units per acre). The southernmost parcel (68 acres) is designated for a wide mix of uses that can include single family residential, multi-family residential, offices and commercial development.

The dominant features are the open, predominantly undisturbed slopes overlooking Cameron Park. These slopes rise up from a low elevation of 1,400 feet to a high point of 1,760 feet. The surrounding land uses are medium to high density residential with commercial and professional land uses to the south and to the north.

It should be noted that although the proposed Cameron Park Preserve is surrounded by established residential and commercial neighborhoods, the parcels recommended for acquisition are the last remaining large parcels that host dense populations of rare plant species in the southern area of the gabbro soils range. DFG believes that acquisition and protection of the proposed Cameron Park Preserve is important for the preservation of six of the eight target plant species. It is particularly critical to Stebbins' morning glory because the greatest number of colonies of this species occurs south of Green Valley Road. Stebbins' morning glory does not occur on the Central Ecological Preserve Areas (Martel Creek, Pine Hill, and Penny Lane Ridge). Although this species does occur in the proposed Salmon Falls Preserve, it is important that the species be protected at more than one location to avoid loss of the species due to a catastrophic event (e.g., out break of a plant disease, fungus or herbivorous insect population). Selected for its particularly fine examples of gabbroic habitat and the greatest variety of rare plant life, creation of the Cameron Park Preserve would create an excellent educational opportunity for local and regional schools and colleges conducting botany and biology classes. It is the site most suitable for public access and the creation of an interpretive trail.

Salmon Falls Preserve

Salmon Falls Preserve is the most northerly and remote Ecological Preserve, located just south of the Folsom State Recreation Area. The proposed Ecological Preserve is slightly east of Salmon Falls Road and mostly south of the South Fork of the American River. Most of the area is west of Kanaka Valley Road. Access is available only on private dirt roads and there are few public services available. Salmon Falls offers the best opportunity for protecting large contiguous areas of rare plant habitat in the northern half of the Rare Soils Study Area. Approximately 656 acres within the Salmon Falls Preserve are in public ownership (BLM and DFG) and are being managed for the protection of rare plants and other natural resources through a Memorandum of Understanding (MOU) between BLM, DFG, and the Bureau of Reclamation (the latter agency controls surface rights on some BLM lands in the vicinity of Salmon Falls).

Of the remaining private land in the proposed Ecological Preserve, the parcels range in size from 4.57 to 229.0 acres and there are over 20 separate ownerships. Most parcels are zoned either residential agricultural or agricultural and some others are zoned residential estate. The land use designation under the proposed General Plan is primarily low density residential (LDR - 5 to 10 acres per unit). The predominant land uses in the Salmon Falls Preserve are vacant rural residential and rural sub-economic units.

The site is characterized by several large undeveloped parcels in a relatively remote rural setting. The property has a rolling terrain and steep slopes varying from 850 to 1,266 feet in elevation. The dominant feature is an officially unnamed peak, often referred to as Morning Glory Hill (elevation 1,266 feet), it is one mile southeast of the Salmon Falls Bridge. The hill and surrounding ridges and slopes form a core area of rare plant density. A low depression to the south of Morning Glory Hill forms a seasonal pond and wetlands area. This site is not suitable for regular public access. Access would be for management purposes or educational or research projects scheduled through an Ecological Preserve

Manager.

Most of the private land in the Salmon Falls area is expected to be dedicated in return for clustered development rights on lands outside of the Ecological Preserve. The *El Dorado County General Plan*, adopted January 23, 1996, sets out the following policies and objectives relating to clustered development:

Policy 2.2.2.4A "The Ecological Preserve overlay designation shall be combined with a basic land use designation that is appropriate for the area. The overlay will enable the land use densities or building intensities for a discretionary project to be transferred to other lands, clustered, or otherwise mitigated to maintain the Preserve."

Policy 7.4.1.1B "Development of mechanisms for the establishment of preserve site(s) such as clustered development, transfers of development rights, mitigation banking, and conservation easements."

Objective 8.1.5 Cluster Development "The County shall encourage cluster development, or grouping together of allowable dwelling units in agricultural districts or lands zoned for agricultural districts, instead of the dispersal of such dwelling units on larger parcels."

Martel Creek Preserve

The Martel Creek Preserve is located 1.5 miles directly west of Pine Hill. The proposed Martel Creek Preserve is slightly west of Deer Valley Road and slightly east and to the south of a bend in Sweetwater Creek. Approximately 200 acres within the Martel Creek Preserve are in public ownership (BLM) and are being managed for the protection of rare plants and other natural resources.

The parcels under private ownership in the proposed Ecological Preserve are rural residential parcels, with an average size of 25.9 acres and a range of 4.0 to 40.0 acres. There are over ten separate ownerships in this unit. Current zoning in this area includes vacant rural residential, residential mobile homes, and rural improved residential. Proposed future land use designations under the General Plan include low density residential (LDR) and rural residential (RR - 10 to 40 acres per unit). The predominant land uses in the proposed Martel Creek Preserve are vacant rural residential and residential mobile home.

The dominant feature in the Martel Creek Preserve is a series of ridges running in a north-south orientation with elevations at the highest point of between 1,200 and 1,381 feet. It is these ridgelines to the north and east of Sweetwater Creek that form a core area of rare plant density in the Martel Creek Preserve. The two creeks, Martel and Sweetwater, provide riparian zones with a year-round flow. Because much of the land in the proposed Ecological Preserve is likely to remain private land with conservation easements held by a local or state agency or a private conservation organization, public access would not be available. The holder of the conservation easement would have access to the site for management purposes with prior notification to the landowner.

Pine Hill Preserve

Pine Hill is located 10 miles east of Folsom and four miles north of Cameron Park. The area is bounded on the north and east by Deer Valley Road, the west by Starbuck Road, and to the south by Green Valley Road. This Ecological Preserve is dominated by a CDF lookout and radio towers on the summit of 2,059 foot high Pine Hill. The map for this Ecological Preserve shows a much larger area than the proposed 700 acre Ecological Preserve. The outline shows an area with a high concentration of rare plant species. The goal is to purchase conservation easements covering a total of 340 acres of rare plant habitat within this area to add to the 360 acres of public land. Funds to purchase conservation easements from willing sellers would be obtained through the funding mechanisms described in Chapter II of this report.

This proposed Ecological Preserve is characterized by many small rural residential parcels and a limited number of roads at the base of the Hill. The average parcel size is 10.62 acres and parcels range in size from 5.0 to 120.0

acres. There are over 100 separate ownerships in this proposed Ecological Preserve. Current zoning in this area is primarily residential estate with 10-acre minimum parcel size; the proposed future land use designation under the General Plan is low density residential (LDR) for all the parcels. The predominant land uses in the proposed Pine Hill Preserve are vacant rural residential, rural improved residential, and residential mobile home. The surrounding lands have mostly been developed into 10-acre rural residential estates.

Approximately 360 acres of the proposed Pine Hill Preserve are already in public ownership. On Pine Hill itself, 240 acres are owned by DFG and 80 acres are owned by CDF. Forty acres are owned by BLM on a ridge one mile northeast of Pine Hill. The BLM land is being managed for the protection of rare plants and other natural resources through a MOU with DFG.

Because much of this Ecological Preserve is to remain private land with conservation easements to be held by a local or state agency or a private conservation organization, public access would not be available. The holder of the easement would be able to access the site for management purposes with prior notification to the landowner. The public lands are currently accessible by appointment only, or to communication facility operators that hold a lease from CDF. This would continue to be the access policy.

Six of eight target species are found on the prominent ridgelines that extend from Pine Hill east, northeast, west, and south. Other significant populations of target species are found on a second ridgeline three-quarters to one mile north of Pine Hill separated by the headwaters of Sweetwater Creek, which runs east to west. This second ridge maintains an elevation of 1,700 to 1,800 feet. Pine Hill and the nearby slopes are one of the two sites in the world that contain Pine Hill flannelbush. The other site is on serpentine soil in Nevada County. This is one of the rarest plants in California, with a total species population of approximately 2,000 plants.

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D. Major Research and Management Needs for Species Covered in the Gabbro Draft Recovery Plan

Species	Research			Management		
	Habitat Surveys	Reproduction and Demography	Systematics and Genetics	Others	Management	Population monitoring
Calystegia stebbinsii (Stebbin's Morning-glory)	Nevada County	yes, including identifying limiting life stages	genetics	fire management techniques	burning	all
Ceanothus roderickii (Pine Hill Ceanothus)		yes	yes	fire management techniques	burning	all
Fremontodendron californicum ssp. *decumbens* (Pine Hill Flannelbush)			yes (identify Yuba County and Nevada County material)	fire management techniques	burning	all
Galium californicum ssp. *sierrae* (El Dorado Bedstraw)	all formerly occupied and potential habitat	yes	genetics	role of fire, germination, & propagation techniques		all
Senecio layneae (Layne's Butterweed)	potential habitat especially in Tuolumne and Yuba County	yes	genetics	role of fire, effect of grazing	disturbance	all
Wyethia reticulata (El Dorado Mule-ears)				fire management techniques	burning	all

END

04-22-99